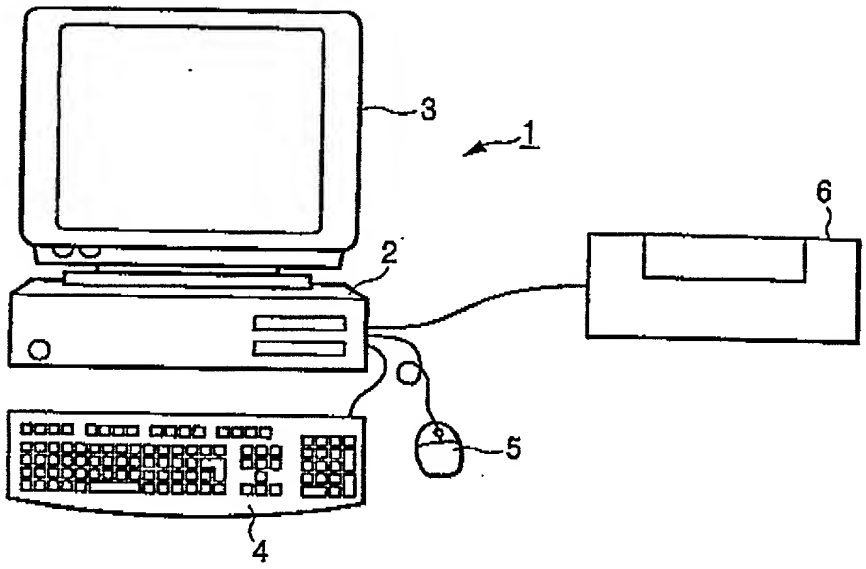
TAKEMURA, et al Q66035
METHOD AND APPARATUS FOR PREDICTING THE LIFE OF A ROLLING BEARING, ROLLING BEARING SELECTION APPARATUS USING THE LIFE PREDICTION APPARATUS, AND STORAGE MEDIUM
FILED: August 29, 2001
1 OF 33

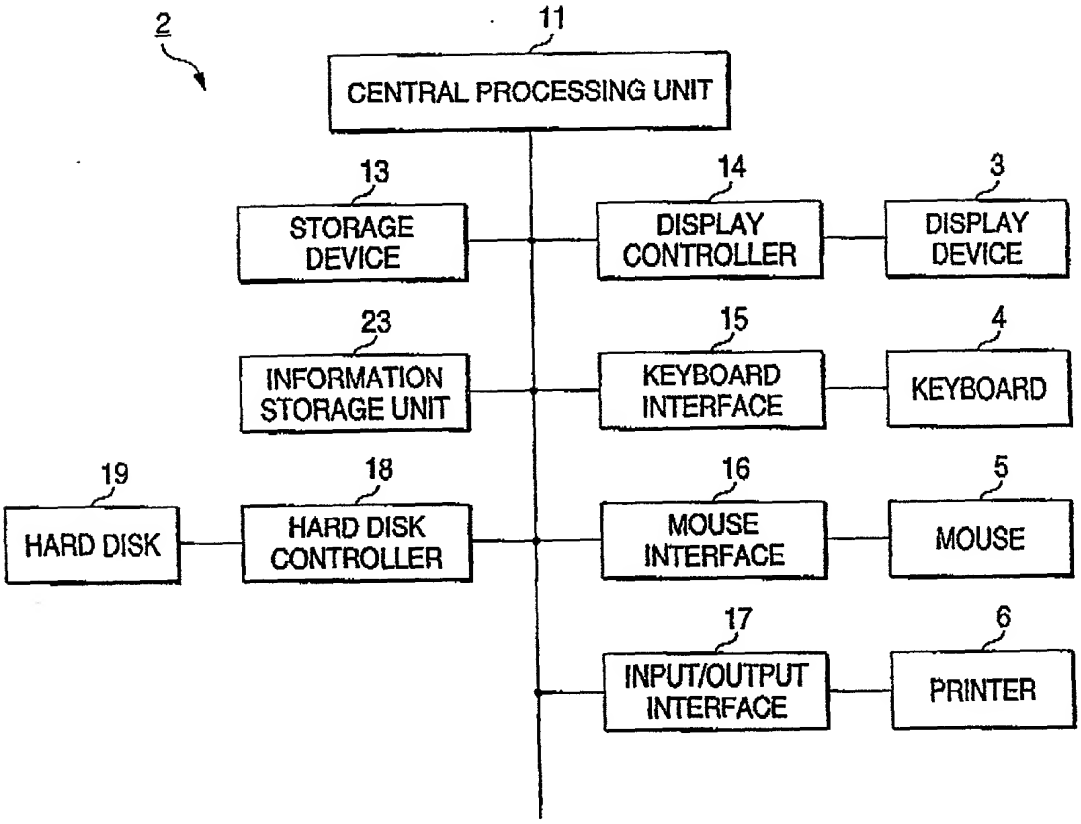
FIG. 1



09405.0088

TAKEMURA, et al Q66035
METHOD AND APPARATUS FOR PREDICTING THE LIFE OF A ROLLING BEARING, ROLLING BEARING SELECTION APPARATUS USING THE LIFE PREDICTION APPARATUS, AND STORAGE MEDIUM
FILED: August 29, 2001
2 OF 33

FIG. 2



TAKEMURA, et al Q66035
METHOD AND APPARATUS FOR PREDICTING THE LIFE OF A ROLLING BEARING, ROLLING BEARING SELECTION APPARATUS USING THE LIFE PREDICTION APPARATUS, AND STORAGE MEDIUM
FILED. August 29, 2001
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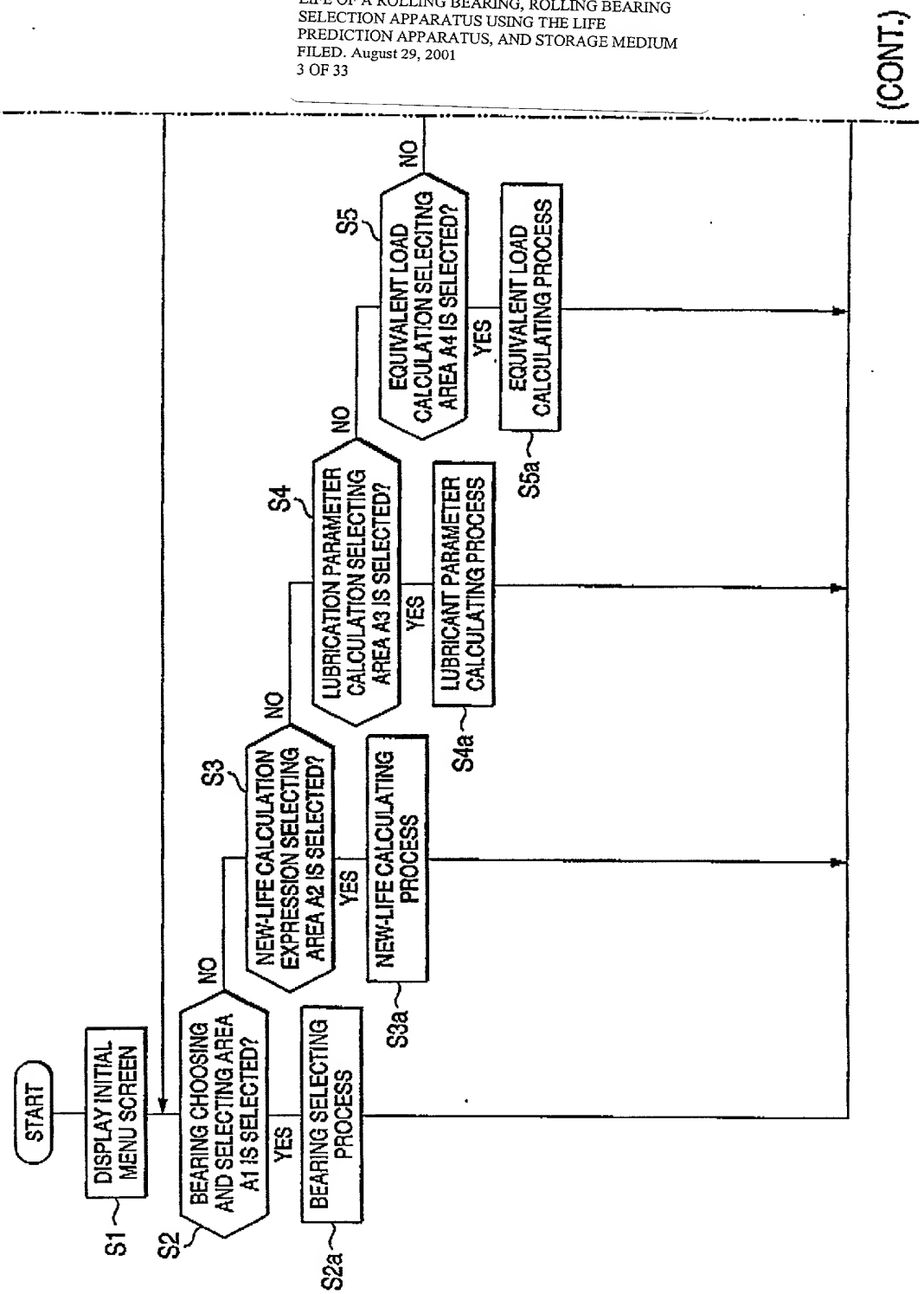
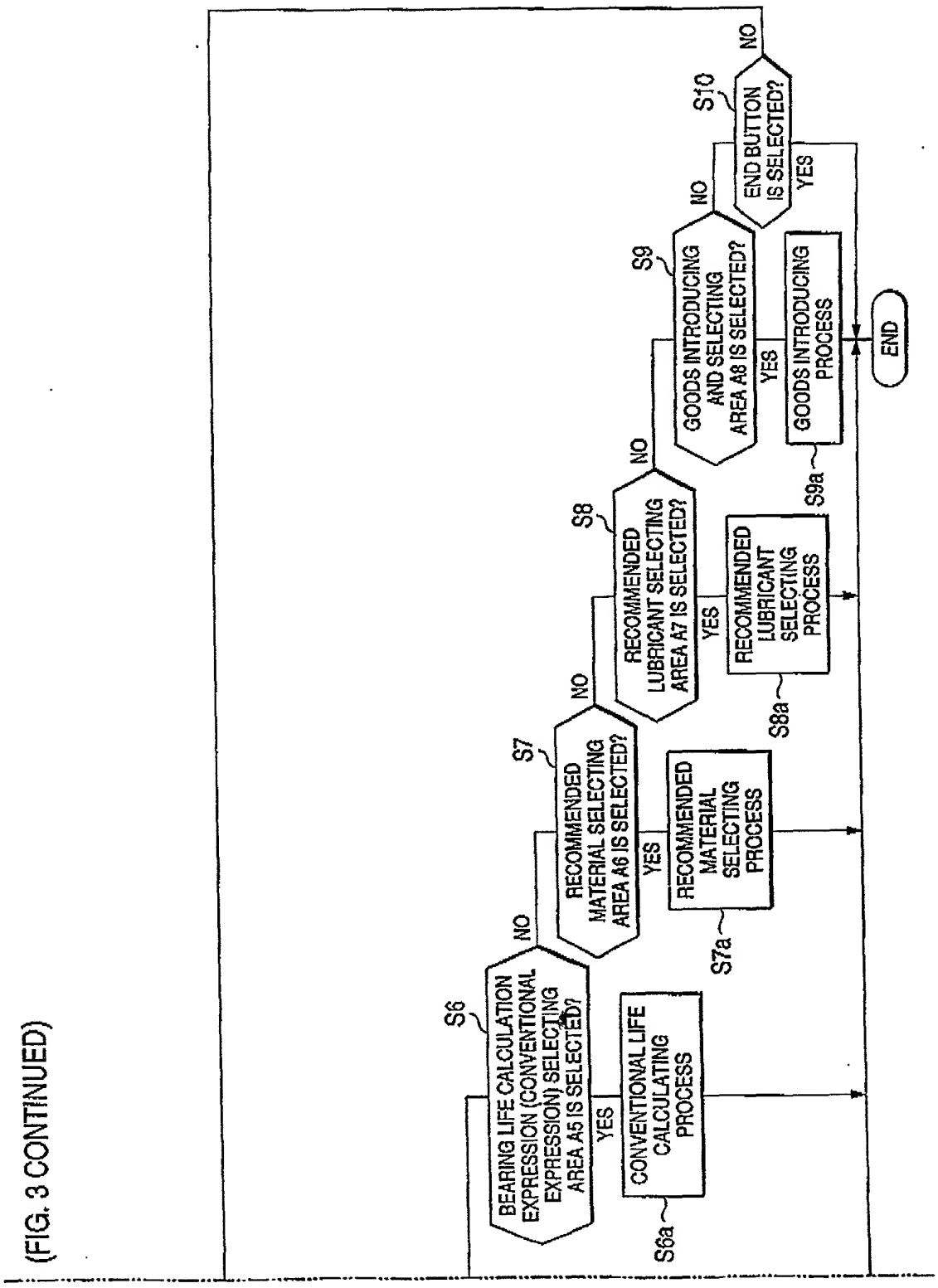
FIG. 3





(FIG. 3 CONTINUED)

FIG. 4

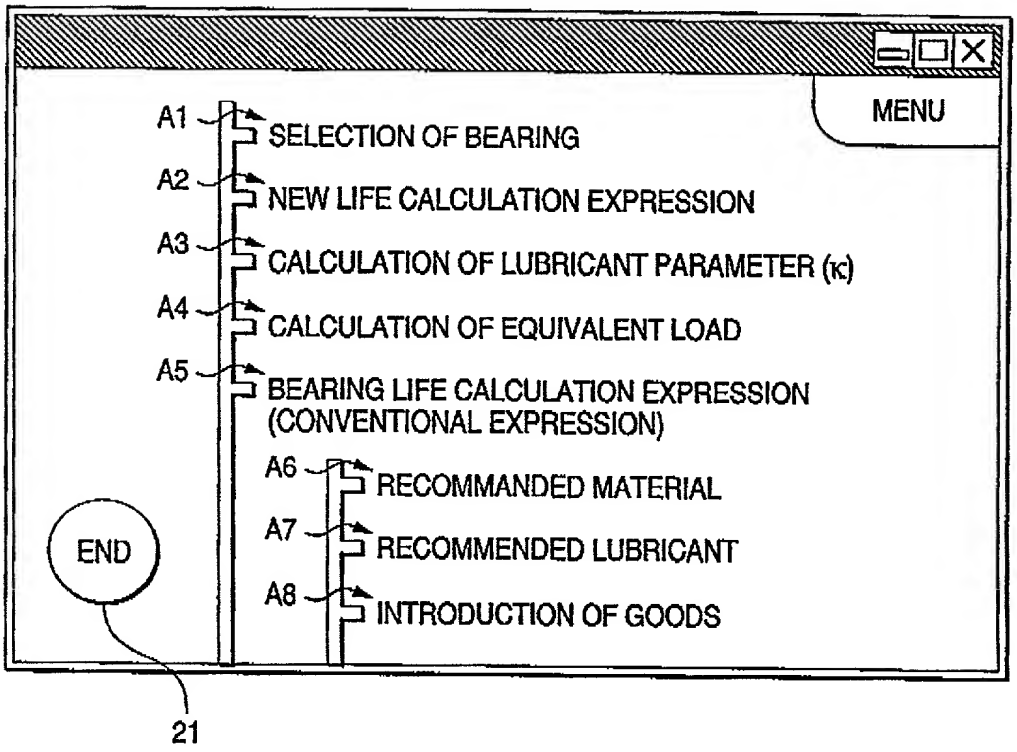
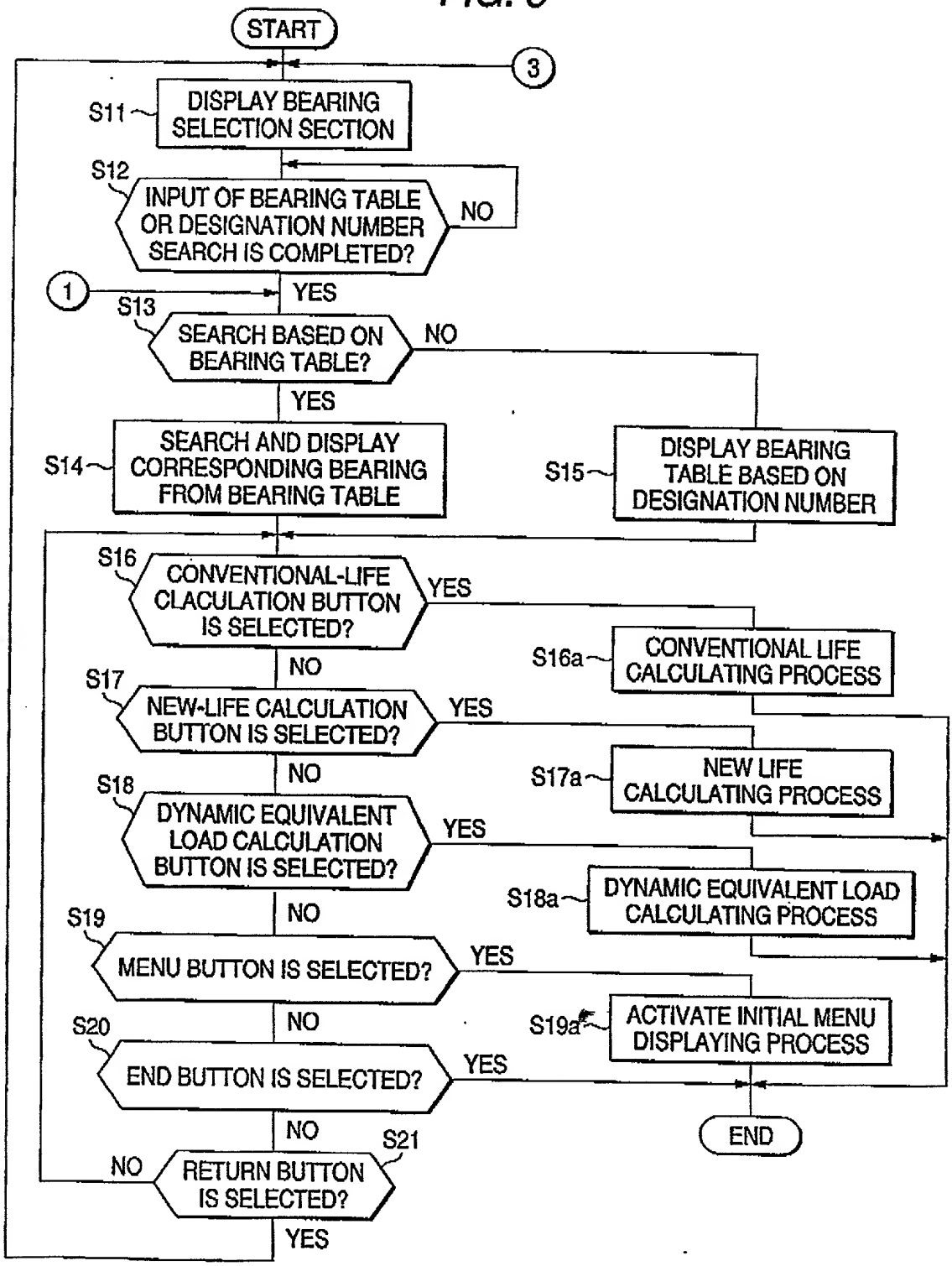

MENU
A1
SELECTION OF BEARING
A2
NEW LIFE CALCULATION EXPRESSION
A3
CALCULATION OF LUBRICANT PARAMETER (κ)
A4
CALCULATION OF EQUIVALENT LOAD
A5
BEARING LIFE CALCULATION EXPRESSION (CONVENTIONAL EXPRESSION)
A6
RECOMMANDED MATERIAL
A7
RECOMMENDED LUBRICANT
A8
INTRODUCTION OF GOODS
END
21

FIG. 5



US 6,804,629 B2

FIG. 6

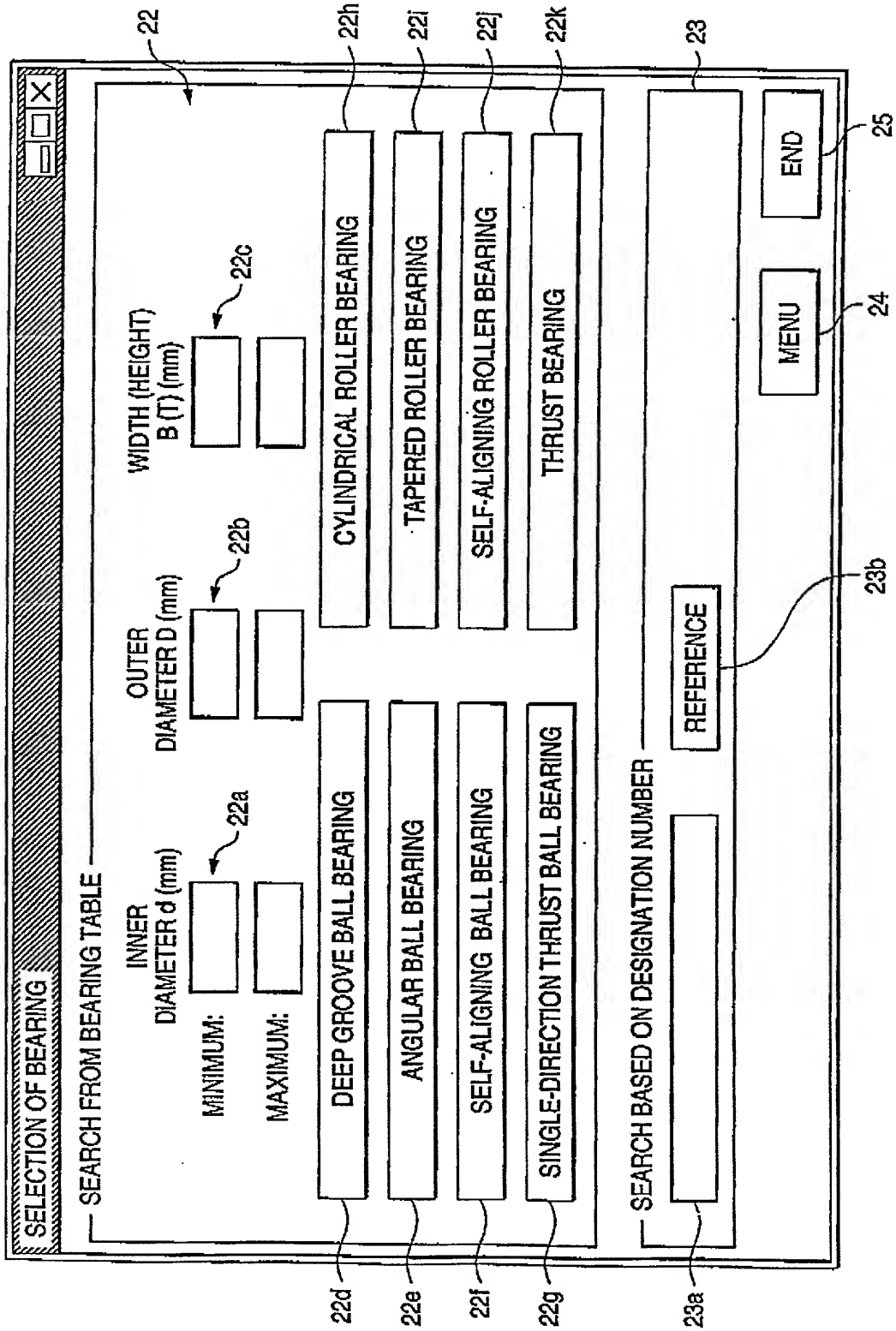
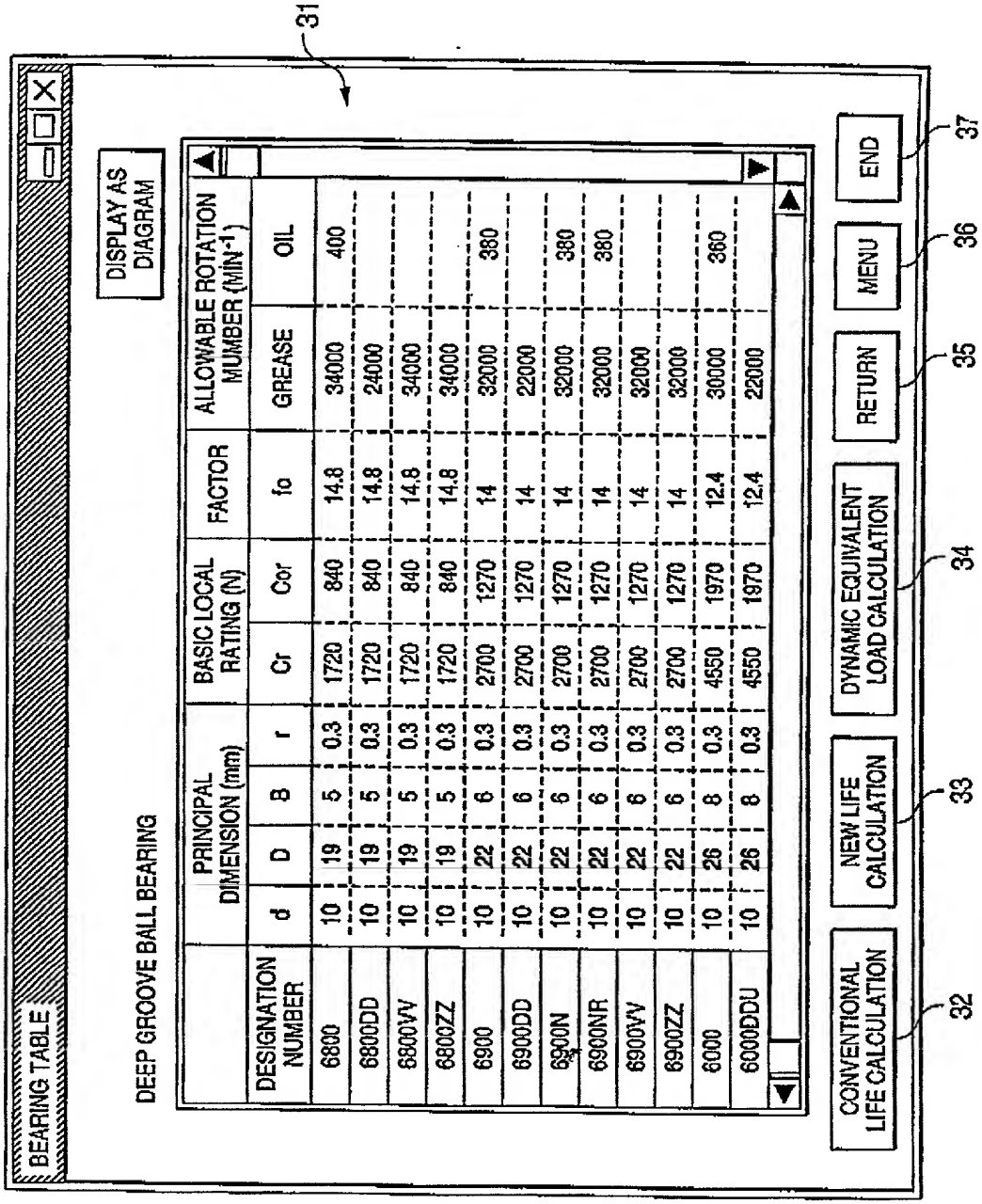

22
22h
22i
22j
22k
23
SELECTION OF BEARING
SEARCH FROM BEARING TABLE
INNER DIAMETER d (mm)
MINIMUM:
MAXIMUM:
22a
OUTER DIAMETER D (mm)
22b
WIDTH (HEIGHT) B (T) (mm)
22c
DEEP GROOVE BALL BEARING
ANGULAR BALL BEARING
SELF-ALIGNING BALL BEARING
SINGLE-DIRECTION THRUST BALL BEARING
CYLINDRICAL ROLLER BEARING
TAPERED ROLLER BEARING
SELF-ALIGNING ROLLER BEARING
THRUST BEARING
SEARCH BASED ON DESIGNATION NUMBER
REFERENCE
23b
MENU
24
END
25
22d
22e
22f
22g
23a

FIG. 7



DESIGNATION NUMBER	PRINCIPAL DIMENSION (mm) d	D	B	r	BASIC LOCAL RATING (N) Cr	Cor	FACTOR fo	ALLOWABLE ROTATION NUMBER (MIN^{-1}) GREASE	OIL
6800	10	19	5	0.3	1720	840	14.8	34000	400
6800DD	10	19	5	0.3	1720	840	14.8	24000	
6800VV	10	19	5	0.3	1720	840	14.8	34000	
6800ZZ	10	19	5	0.3	1720	840	14.8	34000	
6900	10	22	6	0.3	2700	1270	14	32000	380
6900DD	10	22	6	0.3	2700	1270	14	22000	
6900N	10	22	6	0.3	2700	1270	14	32000	380
6900NR	10	22	6	0.3	2700	1270	14	32000	380
6900VV	10	22	6	0.3	2700	1270	14	32000	
6900ZZ	10	22	6	0.3	2700	1270	14	32000	
6000	10	26	8	0.3	4550	1970	12.4	30000	360
6000DDU	10	26	8	0.3	4550	1970	12.4	22000	

FIG. 8

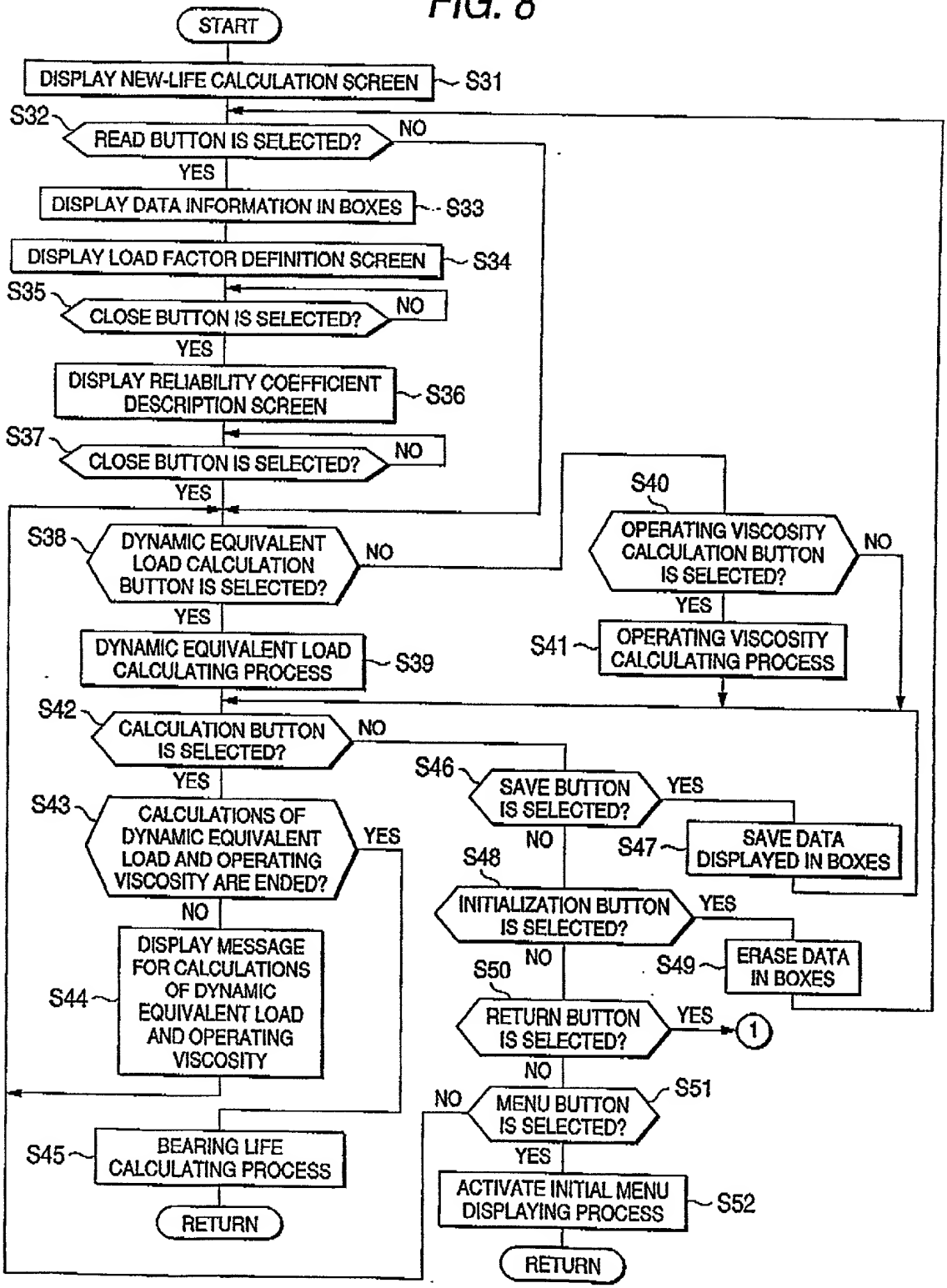

START
DISPLAY NEW-LIFE CALCULATION SCREEN
S31
S32
READ BUTTON IS SELECTED?
NO
YES
DISPLAY DATA INFORMATION IN BOXES
S33
DISPLAY LOAD FACTOR DEFINITION SCREEN
S34
S35
CLOSE BUTTON IS SELECTED?
NO
YES
DISPLAY RELIABILITY COEFFICIENT DESCRIPTION SCREEN
S36
S37
CLOSE BUTTON IS SELECTED?
NO
YES
S38
DYNAMIC EQUIVALENT LOAD CALCULATION BUTTON IS SELECTED?
NO
YES
DYNAMIC EQUIVALENT LOAD CALCULATING PROCESS
S39
S40
OPERATING VISCOSITY CALCULATION BUTTON IS SELECTED?
NO
YES
S41
OPERATING VISCOSITY CALCULATING PROCESS
S42
CALCULATION BUTTON IS SELECTED?
NO
YES
S43
CALCULATIONS OF DYNAMIC EQUIVALENT LOAD AND OPERATING VISCOSITY ARE ENDED?
YES
NO
S44
DISPLAY MESSAGE FOR CALCULATIONS OF DYNAMIC EQUIVALENT LOAD AND OPERATING VISCOSITY
S45
BEARING LIFE CALCULATING PROCESS
RETURN
S46
SAVE BUTTON IS SELECTED?
YES
NO
S47
SAVE DATA DISPLAYED IN BOXES
S48
INITIALIZATION BUTTON IS SELECTED?
YES
NO
S49
ERASE DATA IN BOXES
S50
RETURN BUTTON IS SELECTED?
YES
1
NO
NO
S51
MENU BUTTON IS SELECTED?
YES
ACTIVATE INITIAL MENU DISPLAYING PROCESS
S52
RETURN

FIG. 9

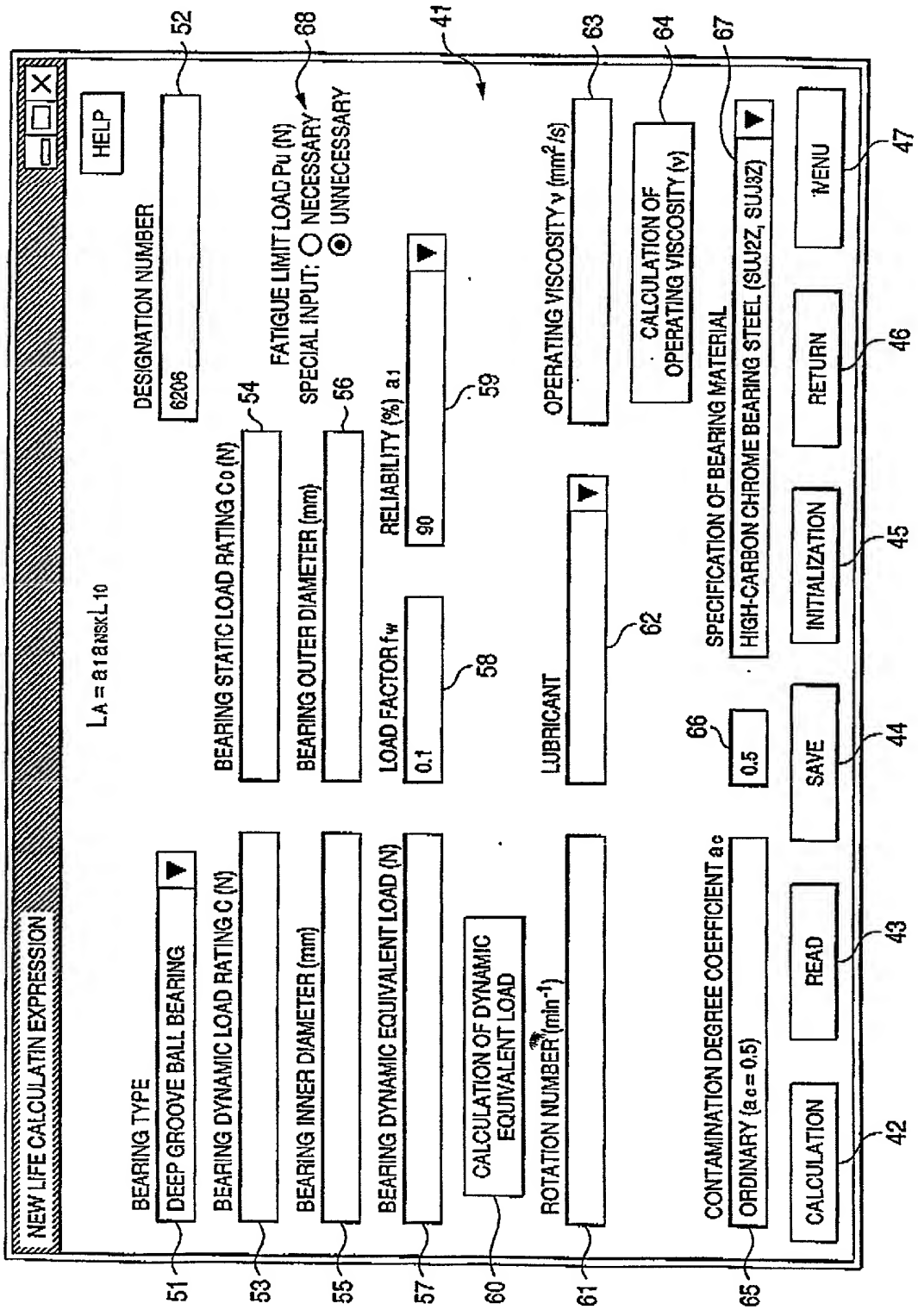

NEW LIFE CALCULATIN EXPRESSION
HELP
LA = a1aNSKL10
DESIGNATION NUMBER
6206
FATIGUE LIMIT LOAD Pu (N)
SPECIAL INPUT: NECESSARY UNNECESSARY
BEARING TYPE
DEEP GROOVE BALL BEARING
BEARING DYNAMIC LOAD RATING C (N)
BEARING INNER DIAMETER (mm)
BEARING DYNAMIC EQUIVALENT LOAD (N)
CALCULATION OF DYNAMIC EQUIVALENT LOAD
ROTATION NUMBER (min-1)
CONTAMINATION DEGREE COEFFICIENT ac
ORDINARY (ac = 0.5)
BEARING STATIC LOAD RATING Co (N)
BEARING OUTER DIAMETER (mm)
LOAD FACTOR fw
0.1
RELIABILITY (%) a1
90
LUBRICANT
0.5
OPERATING VISCOSITY ν (mm2/s)
CALCULATION OF OPERATING VISCOSITY (ν)
SPECIFICATION OF BEARING MATERIAL
HIGH-CARBON CHROME BEARING STEEL (SUJ2Z, SUJ3Z)
CALCULATION
READ
SAVE
INITIALIZATION
RETURN
MENU
42
43
44
45
46
47
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
41

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FIG. 10

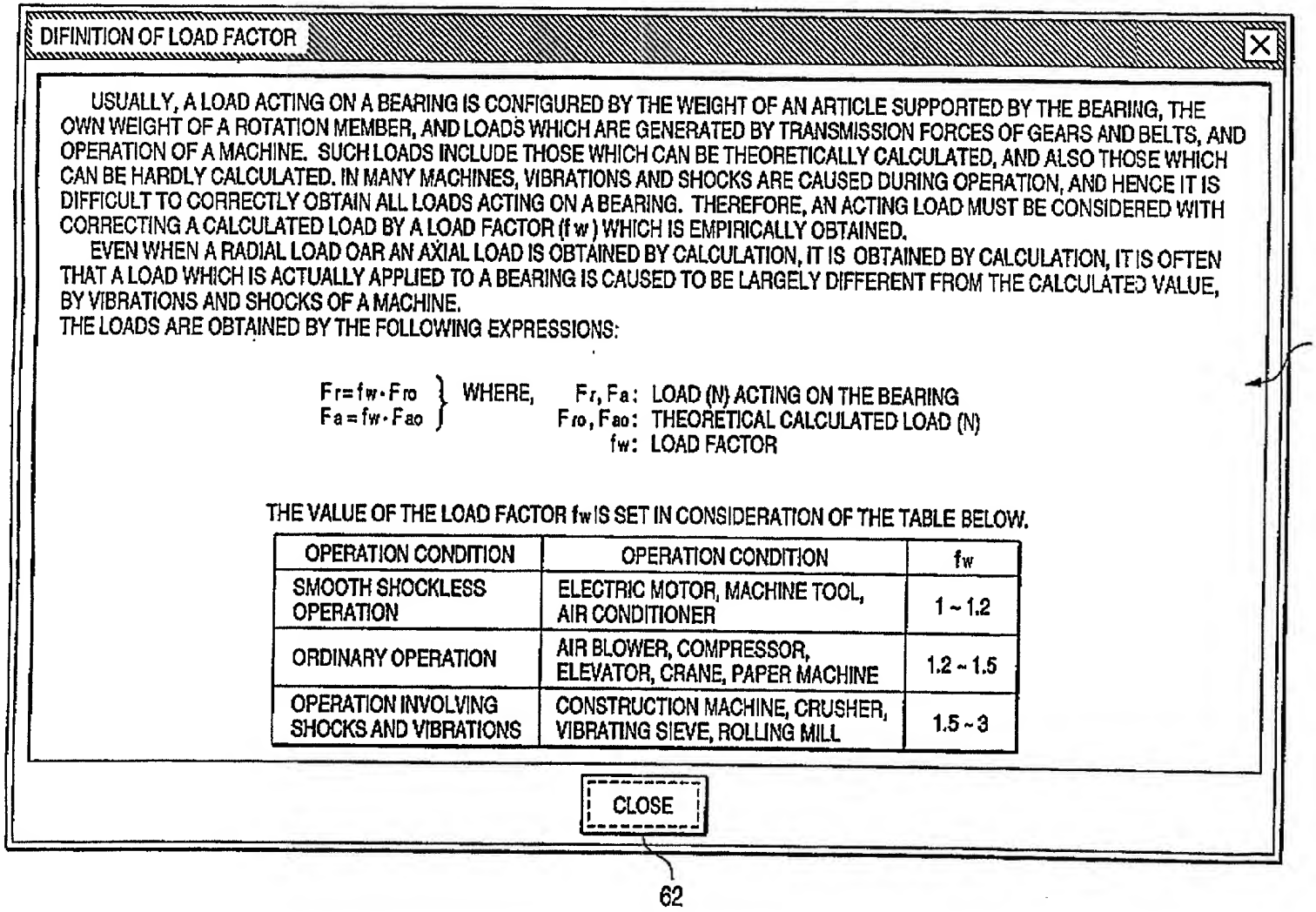


FIG. 11

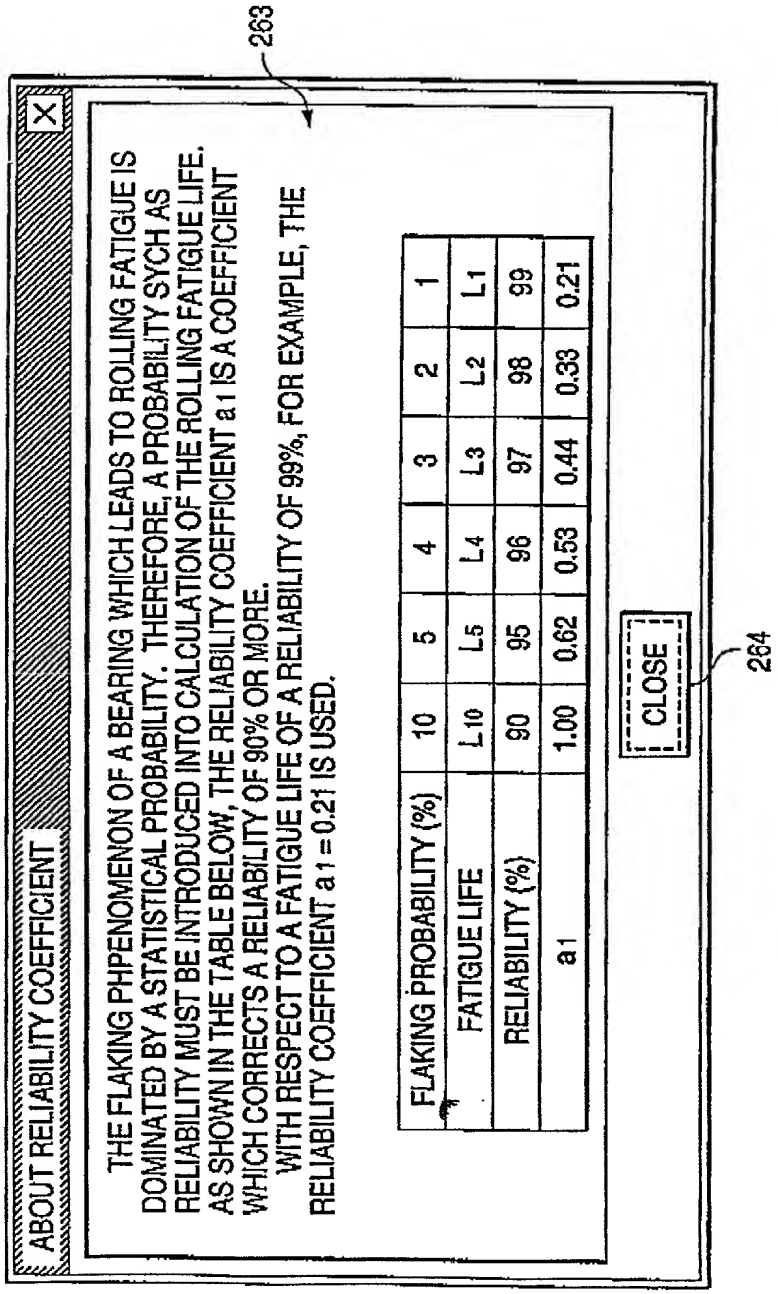

263
ABOUT RELIABILITY COEFFICIENT
THE FLAKING PHPENOMENON OF A BEARING WHICH LEADS TO ROLLING FATIGUE IS DOMINATED BY A STATISTICAL PROBABILITY. THEREFORE, A PROBABILITY SYCH AS RELIABILITY MUST BE INTRODUCED INTO CALCULATION OF THE ROLLING FATIGUE LIFE. AS SHOWN IN THE TABLE BELOW, THE RELIABILITY COEFFICIENT a1 IS A COEFFICIENT WHICH CORRECTS A RELIABILITY OF 90% OR MORE.
WITH RESPECT TO A FATIGUE LIFE OF A RELIABILITY OF 99%, FOR EXAMPLE, THE RELIABILITY COEFFICIENT a1 = 0.21 IS USED.
FLAKING PROBABILITY (%) | 10 | 5 | 4 | 3 | 2 | 1
FATIGUE LIFE | L10 | L5 | L4 | L3 | L2 | L1
RELIABILITY (%) | 90 | 95 | 96 | 97 | 98 | 99
a1 | 1.00 | 0.62 | 0.53 | 0.44 | 0.33 | 0.21
CLOSE
264

FIG. 12

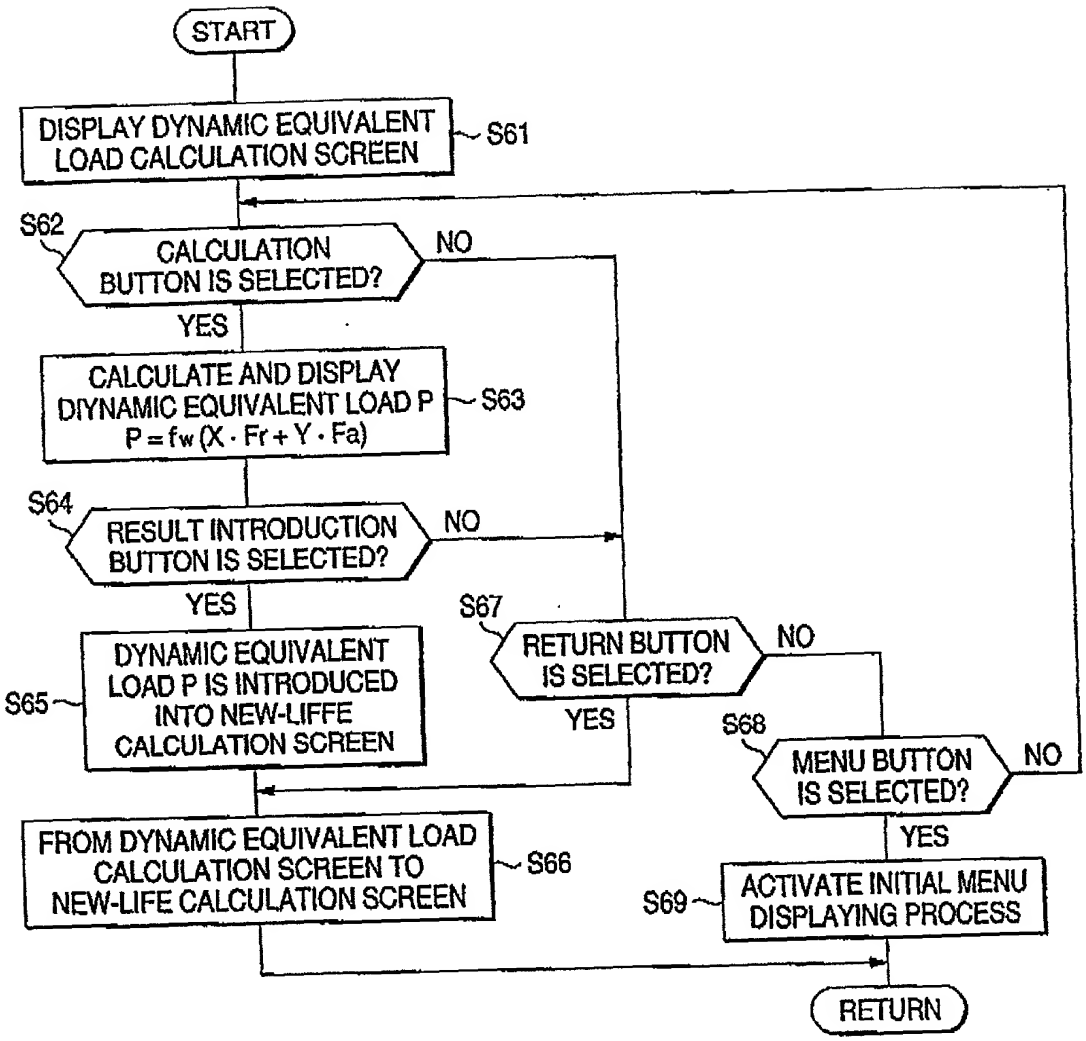

START
DISPLAY DYNAMIC EQUIVALENT LOAD CALCULATION SCREEN
S61
S62
CALCULATION BUTTON IS SELECTED?
NO
YES
CALCULATE AND DISPLAY DIYNAMIC EQUIVALENT LOAD P
P = fw (X · Fr + Y · Fa)
S63
S64
RESULT INTRODUCTION BUTTON IS SELECTED?
NO
YES
S65
DYNAMIC EQUIVALENT LOAD P IS INTRODUCED INTO NEW-LIFFE CALCULATION SCREEN
S67
RETURN BUTTON IS SELECTED?
NO
YES
S68
MENU BUTTON IS SELECTED?
NO
YES
S69
ACTIVATE INITIAL MENU DISPLAYING PROCESS
FROM DYNAMIC EQUIVALENT LOAD CALCULATION SCREEN TO NEW-LIFE CALCULATION SCREEN
S66
RETURN

FIG. 13

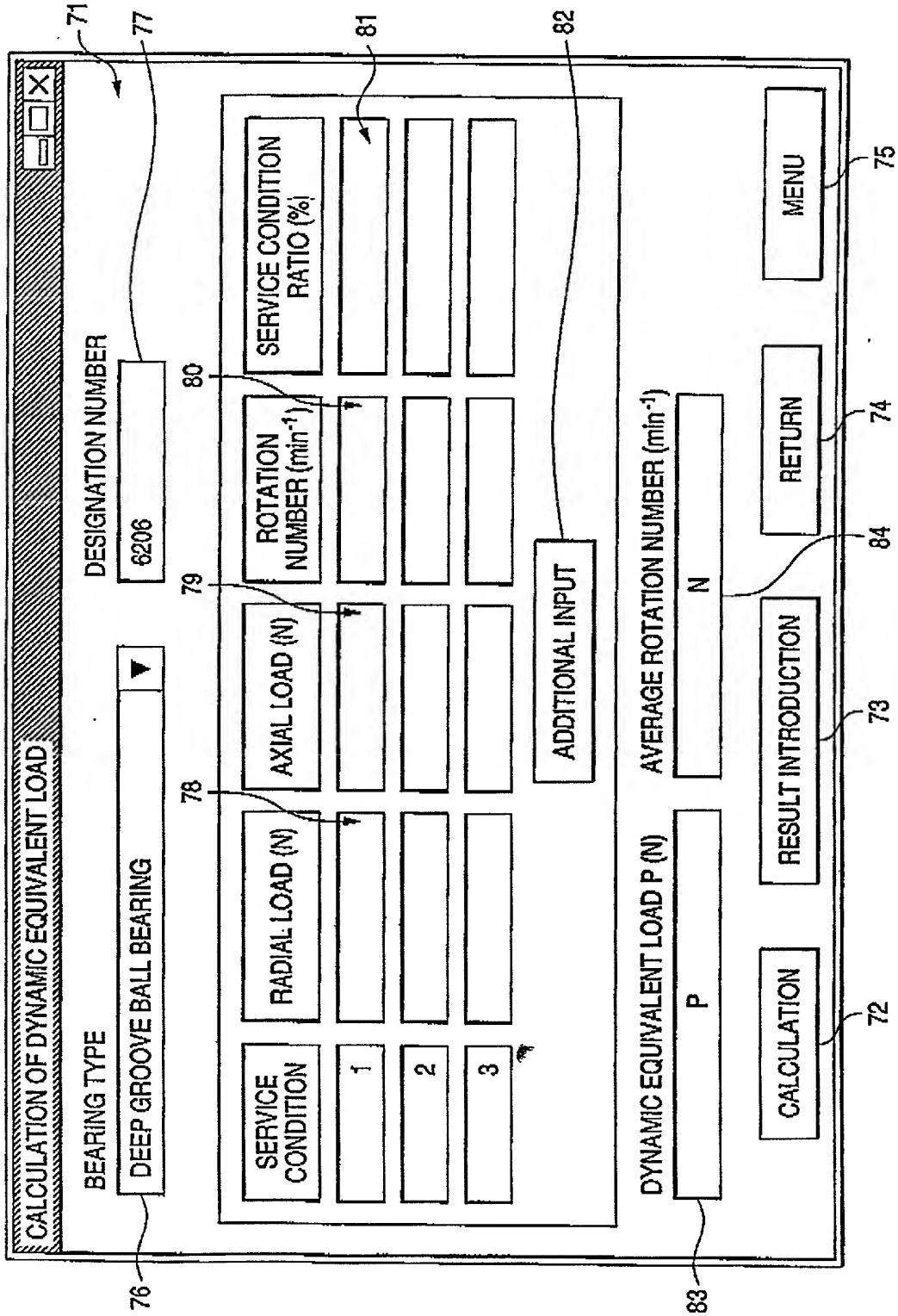

CALCULATION OF DYNAMIC EQUIVALENT LOAD
BEARING TYPE
DEEP GROOVE BALL BEARING
DESIGNATION NUMBER
6206
SERVICE CONDITION
RADIAL LOAD (N)
AXIAL LOAD (N)
ROTATION NUMBER (min-1)
SERVICE CONDITION RATIO (%)
1
2
3
ADDITIONAL INPUT
AVERAGE ROTATION NUMBER (min-1)
N
DYNAMIC EQUIVALENT LOAD P (N)
P
CALCULATION
RESULT INTRODUCTION
RETURN
MENU
71
72
73
74
75
76
77
78
79
80
81
82
83
84

FIG. 14

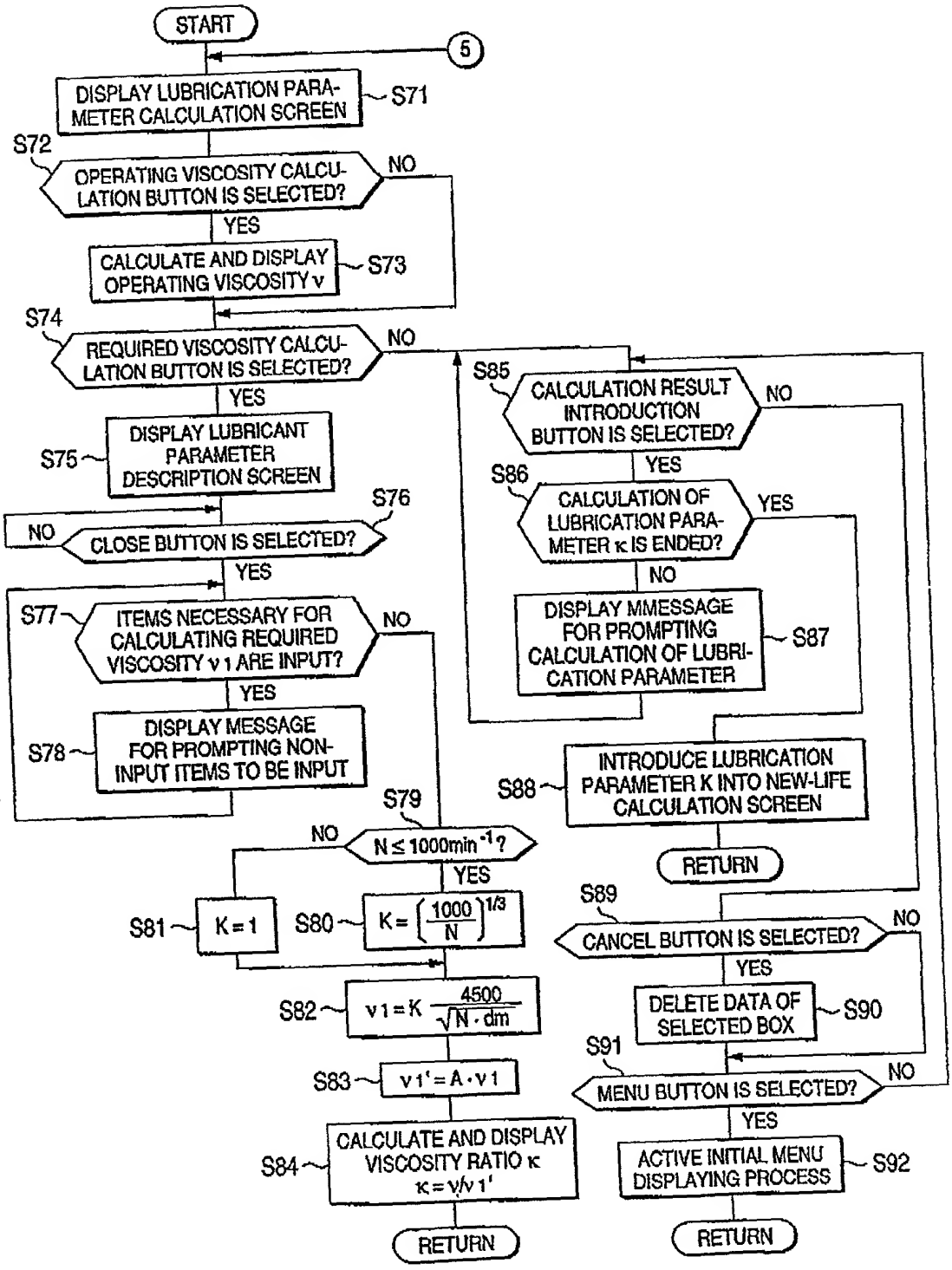

START
5
DISPLAY LUBRICATION PARAMETER CALCULATION SCREEN
S71
S72
OPERATING VISCOSITY CALCULATION BUTTON IS SELECTED?
NO
YES
CALCULATE AND DISPLAY OPERATING VISCOSITY ν
S73
S74
REQUIRED VISCOSITY CALCULATION BUTTON IS SELECTED?
NO
YES
S75
DISPLAY LUBRICANT PARAMETER DESCRIPTION SCREEN
S76
NO
CLOSE BUTTON IS SELECTED?
YES
S77
ITEMS NECESSARY FOR CALCULATING REQUIRED VISCOSITY ν1 ARE INPUT?
NO
YES
S78
DISPLAY MESSAGE FOR PROMPTING NON-INPUT ITEMS TO BE INPUT
S79
NO
N ≤ 1000min⁻¹?
YES
S81
K=1
S80
K = (1000/N)^1/3
S82
ν1 = K 4500/√N·dm
S83
ν1' = A·ν1
S84
CALCULATE AND DISPLAY VISCOSITY RATIO κ
κ = ν/ν1'
RETURN
S85
CALCULATION RESULT INTRODUCTION BUTTON IS SELECTED?
NO
YES
S86
CALCULATION OF LUBRICATION PARAMETER κ IS ENDED?
YES
NO
DISPLAY MMESSAGE FOR PROMPTING CALCULATION OF LUBRICATION PARAMETER
S87
S88
INTRODUCE LUBRICATION PARAMETER K INTO NEW-LIFE CALCULATION SCREEN
RETURN
S89
CANCEL BUTTON IS SELECTED?
NO
YES
DELETE DATA OF SELECTED BOX
S90
S91
MENU BUTTON IS SELECTED?
NO
YES
ACTIVE INITIAL MENU DISPLAYING PROCESS
S92
RETURN

FIG. 15

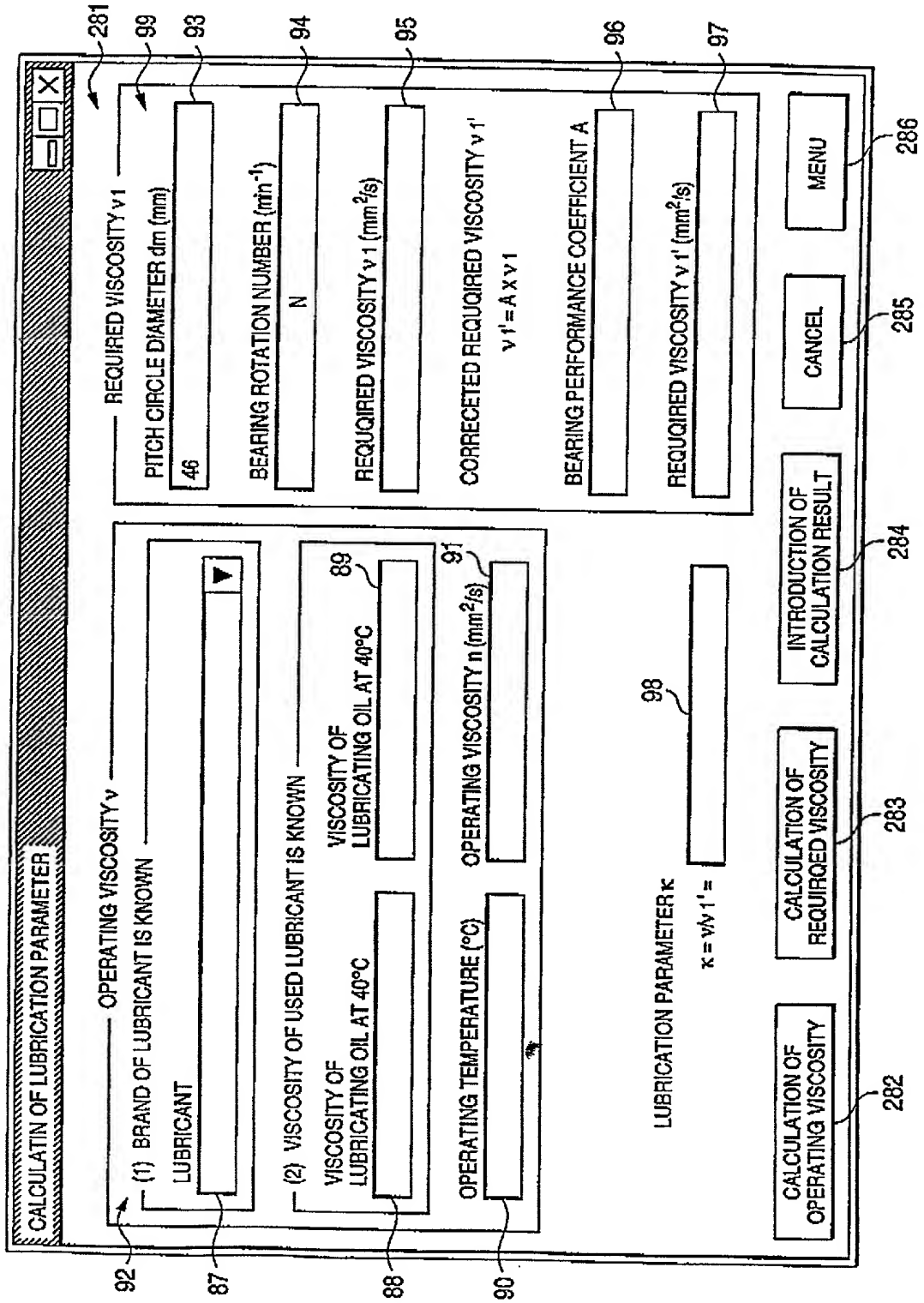

281
99
93
94
95
96
97
REQUIRED VISCOSITY ν1
PITCH CIRCLE DIAMETER dm (mm)
46
BEARING ROTATION NUMBER (min-1)
N
REQUIRED VISCOSITY ν1 (mm2/s)
CORRECTED REQUIRED VISCOSITY ν1'
ν1'=AXν1
BEARING PERFORMANCE COEFFICIENT A
REQUIRED VISCOSITY ν1' (mm2/s)
CALCULATIN OF LUBRICATION PARAMETER
OPERATING VISCOSITY ν
(1) BRAND OF LUBRICANT IS KNOWN
LUBRICANT
(2) VISCOSITY OF USED LUBRICANT IS KNOWN
VISCOSITY OF LUBRICATING OIL AT 40°C
VISCOSITY OF LUBRICATING OIL AT 40°C
OPERATING TEMPERATURE (°C)
OPERATING VISCOSITY n (mm2/s)
LUBRICATION PARAMETER κ
κ=ν/ν1'=
CALCULATION OF OPERATING VISCOSITY
CALCULATION OF REQUIRED VISCOSITY
INTRODUCTION OF CALCULATION RESULT
CANCEL
MENU
92
87
88
89
90
91
98
282
283
284
285
286

FIG. 16

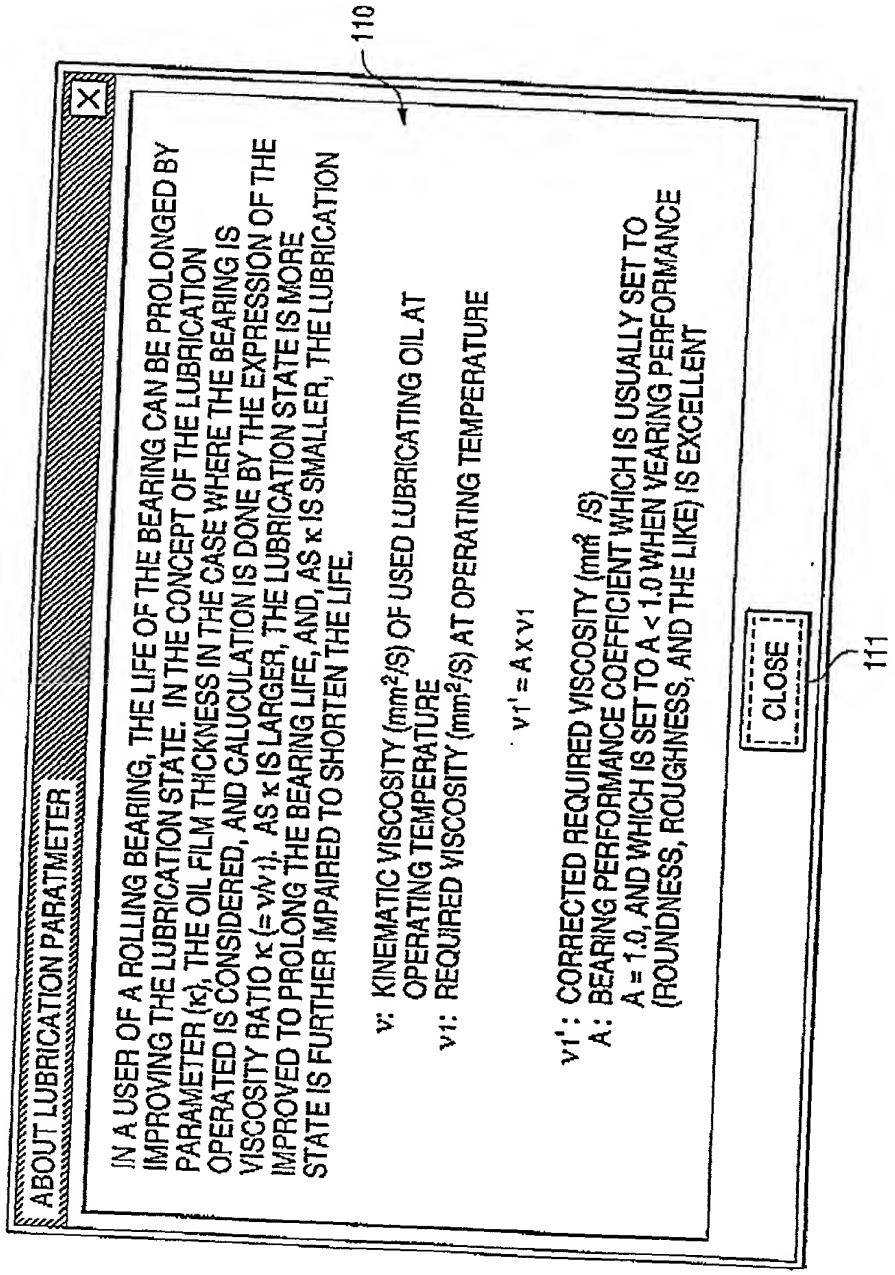

ABOUT LUBRICATION PARATMETER
IN A USER OF A ROLLING BEARING, THE LIFE OF THE BEARING CAN BE PROLONGED BY IMPROVING THE LUBRICATION STATE. IN THE CONCEPT OF THE LUBRICATION PARAMETER (κ), THE OIL FILM THICKNESS IN THE CASE WHERE THE BEARING IS OPERATED IS CONSIDERED, AND CALUCULATION IS DONE BY THE EXPRESSION OF THE VISCOSITY RATIO κ (= ν/ν1). AS κ IS LARGER, THE LUBRICATION STATE IS MORE IMPROVED TO PROLONG THE BEARING LIFE, AND, AS κ IS SMALLER, THE LUBRICATION STATE IS FURTHER IMPAIRED TO SHORTEN THE LIFE.
ν: KINEMATIC VISCOSITY (mm²/S) OF USED LUBRICATING OIL AT OPERATING TEMPERATURE
ν1: REQUIRED VISCOSITY (mm²/S) AT OPERATING TEMPERATURE
ν1' = A x ν1
ν1': CORRECTED REQUIRED VISCOSITY (mm² /S)
A: BEARING PERFORMANCE COEFFICIENT WHICH IS USUALLY SET TO A = 1.0, AND WHICH IS SET TO A < 1.0 WHEN WEARING PERFORMANCE (ROUNDNESS, ROUGHNESS, AND THE LIKE) IS EXCELLENT
CLOSE
110
111

FIG. 17

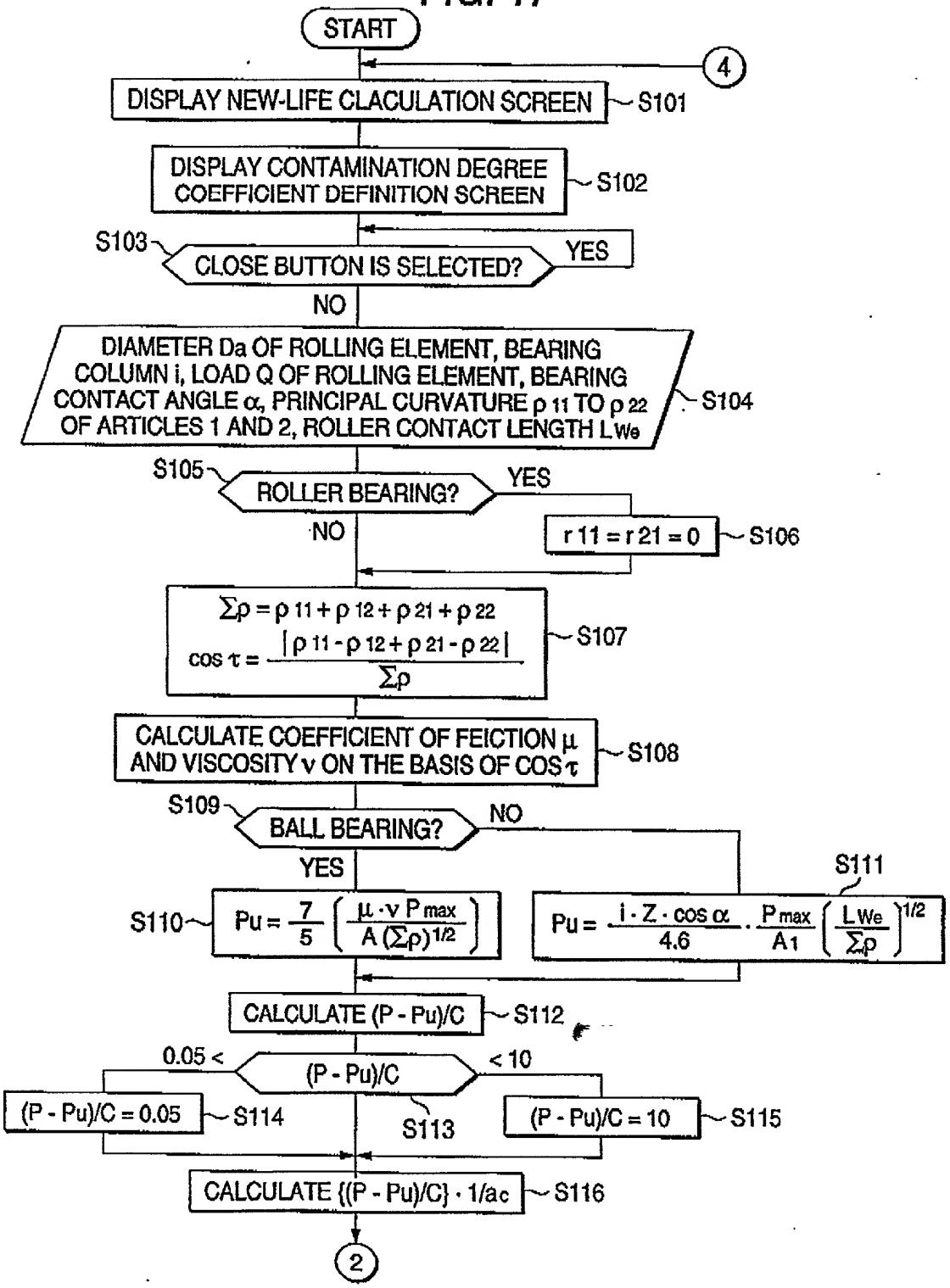

START
4
DISPLAY NEW-LIFE CLACULATION SCREEN
S101
DISPLAY CONTAMINATION DEGREE COEFFICIENT DEFINITION SCREEN
S102
S103
CLOSE BUTTON IS SELECTED?
YES
NO
DIAMETER Da OF ROLLING ELEMENT, BEARING COLUMN i, LOAD Q OF ROLLING ELEMENT, BEARING CONTACT ANGLE α, PRINCIPAL CURVATURE ρ 11 TO ρ 22 OF ARTICLES 1 AND 2, ROLLER CONTACT LENGTH LWe
S104
S105
ROLLER BEARING?
YES
NO
r 11 = r 21 = 0
S106
Σρ = ρ 11 + ρ 12 + ρ 21 + ρ 22
cos τ = |ρ 11 - ρ 12 + ρ 21 - ρ 22| / Σρ
S107
CALCULATE COEFFICIENT OF FEICTION μ AND VISCOSITY ν ON THE BASIS OF COS τ
S108
S109
BALL BEARING?
NO
YES
S110
Pu = 7/5 (μ·ν Pmax / A(Σρ)^1/2)
S111
Pu = i·Z·cos α / 4.6 · Pmax/A1 (LWe/Σρ)^1/2
CALCULATE (P - Pu)/C
S112
0.05 <
(P - Pu)/C
< 10
S113
(P - Pu)/C = 0.05
S114
(P - Pu)/C = 10
S115
CALCULATE {(P - Pu)/C} · 1/ac
S116
2

FIG. 18

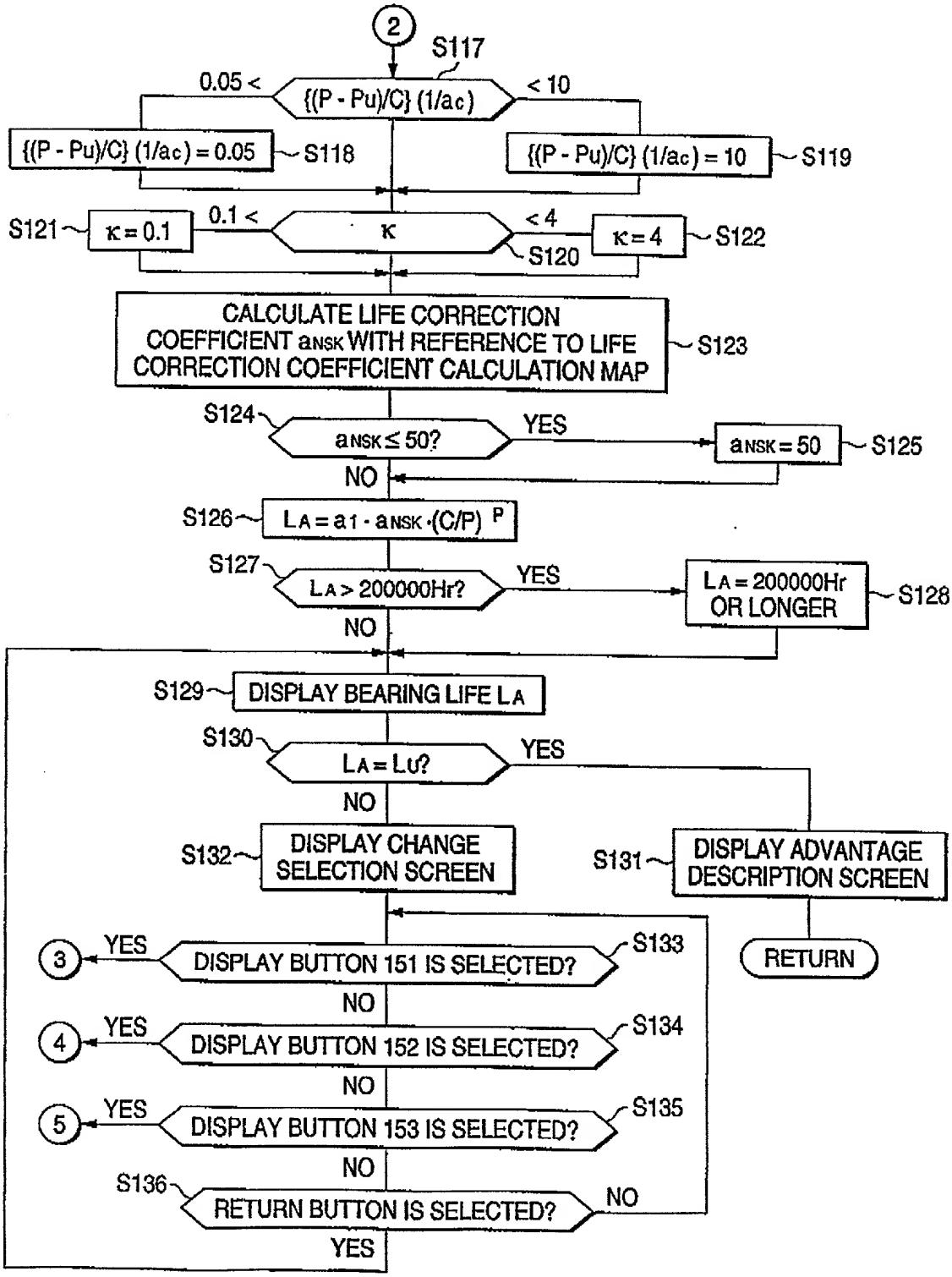

2
S117
0.05 <
{(P - Pu)/C} (1/ac)
< 10
{(P - Pu)/C} (1/ac) = 0.05
S118
{(P - Pu)/C} (1/ac) = 10
S119
S121
κ = 0.1
0.1 <
κ
< 4
κ = 4
S122
S120
CALCULATE LIFE CORRECTION COEFFICIENT aNSK WITH REFERENCE TO LIFE CORRECTION COEFFICIENT CALCULATION MAP
S123
S124
aNSK ≤ 50?
YES
aNSK = 50
S125
NO
S126
LA = a1 · aNSK · (C/P) P
S127
LA > 200000Hr?
YES
LA = 200000Hr OR LONGER
S128
NO
S129
DISPLAY BEARING LIFE LA
S130
LA = Lu?
YES
NO
S132
DISPLAY CHANGE SELECTION SCREEN
S131
DISPLAY ADVANTAGE DESCRIPTION SCREEN
3
YES
DISPLAY BUTTON 151 IS SELECTED?
S133
RETURN
NO
4
YES
DISPLAY BUTTON 152 IS SELECTED?
S134
NO
5
YES
DISPLAY BUTTON 153 IS SELECTED?
S135
NO
S136
RETURN BUTTON IS SELECTED?
NO
YES

FIG. 19

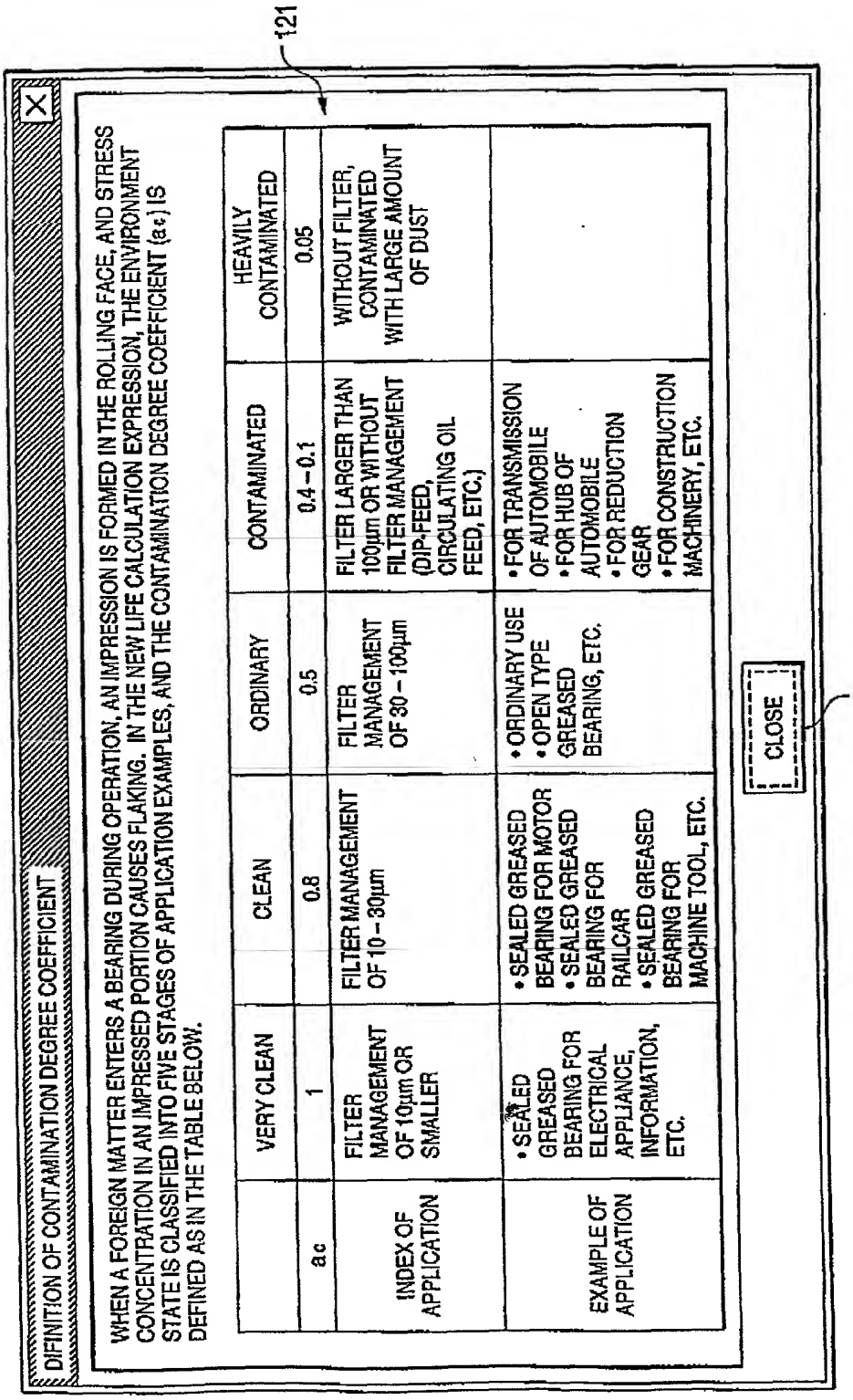

DIFINITION OF CONTAMINATION DEGREE COEFFICIENT
WHEN A FOREIGN MATTER ENTERS A BEARING DURING OPERATION, AN IMPRESSION IS FORMED IN THE ROLLING FACE, AND STRESS CONCENTRATION IN AN IMPRESSED PORTION CAUSES FLAKING. IN THE NEW LIFE CALCULATION EXPRESSION, THE ENVIRONMENT STATE IS CLASSIFIED INTO FIVE STAGES OF APPLICATION EXAMPLES, AND THE CONTAMINATION DEGREE COEFFICIENT (ac) IS DEFINED AS IN THE TABLE BELOW.
121
VERY CLEAN
CLEAN
ORDINARY
CONTAMINATED
HEAVILY CONTAMINATED
ac
1
0.8
0.5
0.4 – 0.1
0.05
INDEX OF APPLICATION
FILTER MANAGEMENT OF 10μm OR SMALLER
FILTER MANAGEMENT OF 10 – 30μm
FILTER MANAGEMENT OF 30 – 100μm
FILTER LARGER THAN 100μm OR WITHOUT FILTER MANAGEMENT (DIP-FEED, CIRCULATING OIL FEED, ETC.)
WITHOUT FILTER, CONTAMINATED WITH LARGE AMOUNT OF DUST
EXAMPLE OF APPLICATION
• SEALED GREASED BEARING FOR ELECTRICAL APPLIANCE, INFORMATION, ETC.
• SEALED GREASED BEARING FOR MOTOR
• SEALED GREASED BEARING FOR RAILCAR
• SEALED GREASED BEARING FOR MACHINE TOOL, ETC.
• ORDINARY USE
• OPEN TYPE GREASED BEARING, ETC.
• FOR TRANSMISSION OF AUTOMOBILE
• FOR HUB OF AUTOMOBILE
• FOR REDUCTION GEAR
• FOR CONSTRUCTION MACHINERY, ETC.
CLOSE
122

FIG. 20

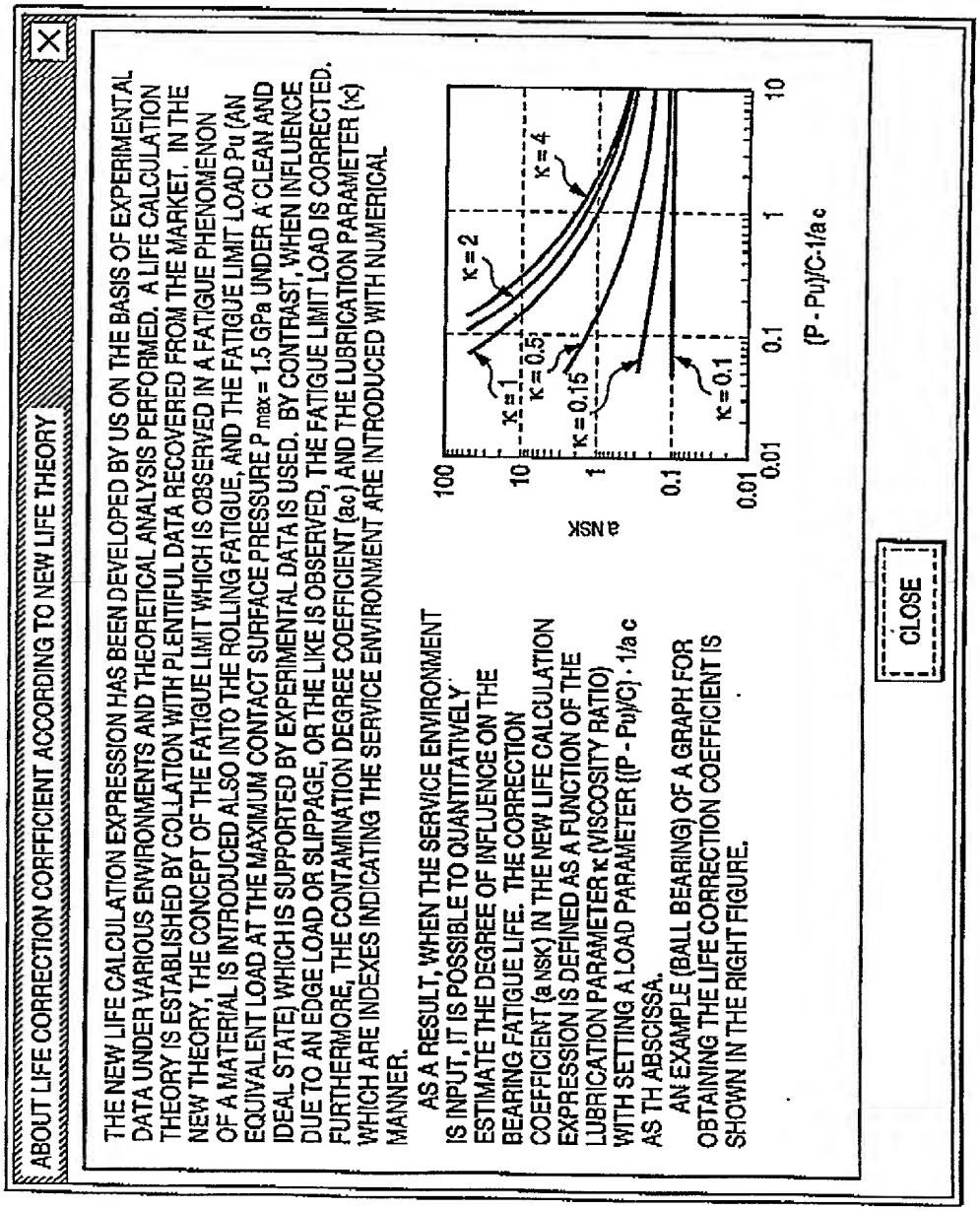

ABOUT LIFE CORRECTION CORFFICIENT ACCORDING TO NEW LIFE THEORY
THE NEW LIFE CALCULATION EXPRESSION HAS BEEN DEVELOPED BY US ON THE BASIS OF EXPERIMENTAL DATA UNDER VARIOUS ENVIRONMENTS AND THEORETICAL ANALYSIS PERFORMED. A LIFE CALCULATION THEORY IS ESTABLISHED BY COLLATION WITH PLENTIFUL DATA RECOVERED FROM THE MARKET. IN THE NEW THEORY, THE CONCEPT OF THE FATIGUE LIMIT WHICH IS OBSERVED IN A FATIGUE PHENOMENON OF A MATERIAL IS INTRODUCED ALSO INTO THE ROLLING FATIGUE, AND THE FATIGUE LIMIT LOAD Pu (AN EQUIVALENT LOAD AT THE MAXIMUM CONTACT SURFACE PRESSURE P max = 1.5 GPa UNDER A CLEAN AND IDEAL STATE) WHICH IS SUPPORTED BY EXPERIMENTAL DATA IS USED. BY CONTRAST, WHEN INFLUENCE DUE TO AN EDGE LOAD OR SLIPPAGE, OR THE LIKE IS OBSERVED, THE FATIGUE LIMIT LOAD IS CORRECTED. FURTHERMORE, THE CONTAMINATION DEGREE COEFFICIENT (ac) AND THE LUBRICATION PARAMETER (κ) WHICH ARE INDEXES INDICATING THE SERVICE ENVIRONMENT ARE INTRODUCED WITH NUMERICAL MANNER.
AS A RESULT, WHEN THE SERVICE ENVIRONMENT IS INPUT, IT IS POSSIBLE TO QUANTITATIVELY ESTIMATE THE DEGREE OF INFLUENCE ON THE BEARING FATIGUE LIFE. THE CORRECTION COEFFICIENT (a NSK) IN THE NEW LIFE CALCULATION EXPRESSION IS DEFINED AS A FUNCTION OF THE LUBRICATION PARAMETER κ (VISCOSITY RATIO) WITH SETTING A LOAD PARAMETER ((P - Pu)/C) · 1/a c AS TH ABSCISSA.
AN EXAMPLE (BALL BEARING) OF A GRAPH FOR OBTAINING THE LIFE CORRECTION COEFFICIENT IS SHOWN IN THE RIGHT FIGURE.
CLOSE
a NSK
100
10
1
0.1
0.01
κ = 2
κ = 1
κ = 0.5
κ = 0.15
κ = 4
κ = 0.1
0.01
0.1
1
10
(P - Pu)/C-1/a c

FIG. 21

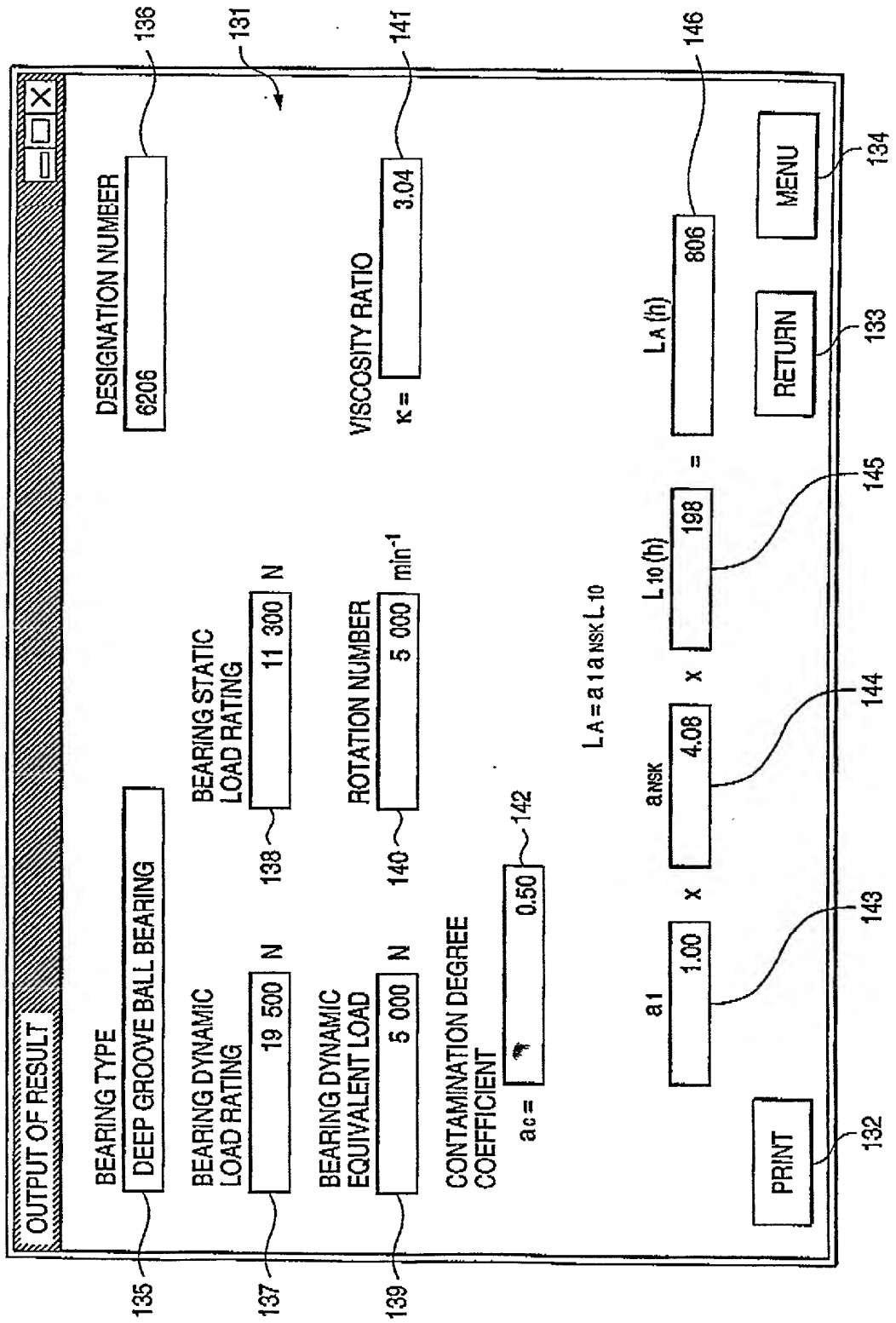

OUTPUT OF RESULT
BEARING TYPE
DEEP GROOVE BALL BEARING
135
DESIGNATION NUMBER
6206
136
131
VISCOSITY RATIO
κ =
3.04
141
BEARING DYNAMIC LOAD RATING
19 500
N
137
BEARING STATIC LOAD RATING
11 300
N
138
BEARING DYNAMIC EQUIVALENT LOAD
5 000
N
139
ROTATION NUMBER
5 000
min-1
140
CONTAMINATION DEGREE COEFFICIENT
ac =
0.50
142
LA = a1 aNSK L10
a1
1.00
x
aNSK
4.08
x
L10 (h)
198
=
LA (h)
806
146
145
144
143
PRINT
132
RETURN
133
MENU
134

FIG. 22

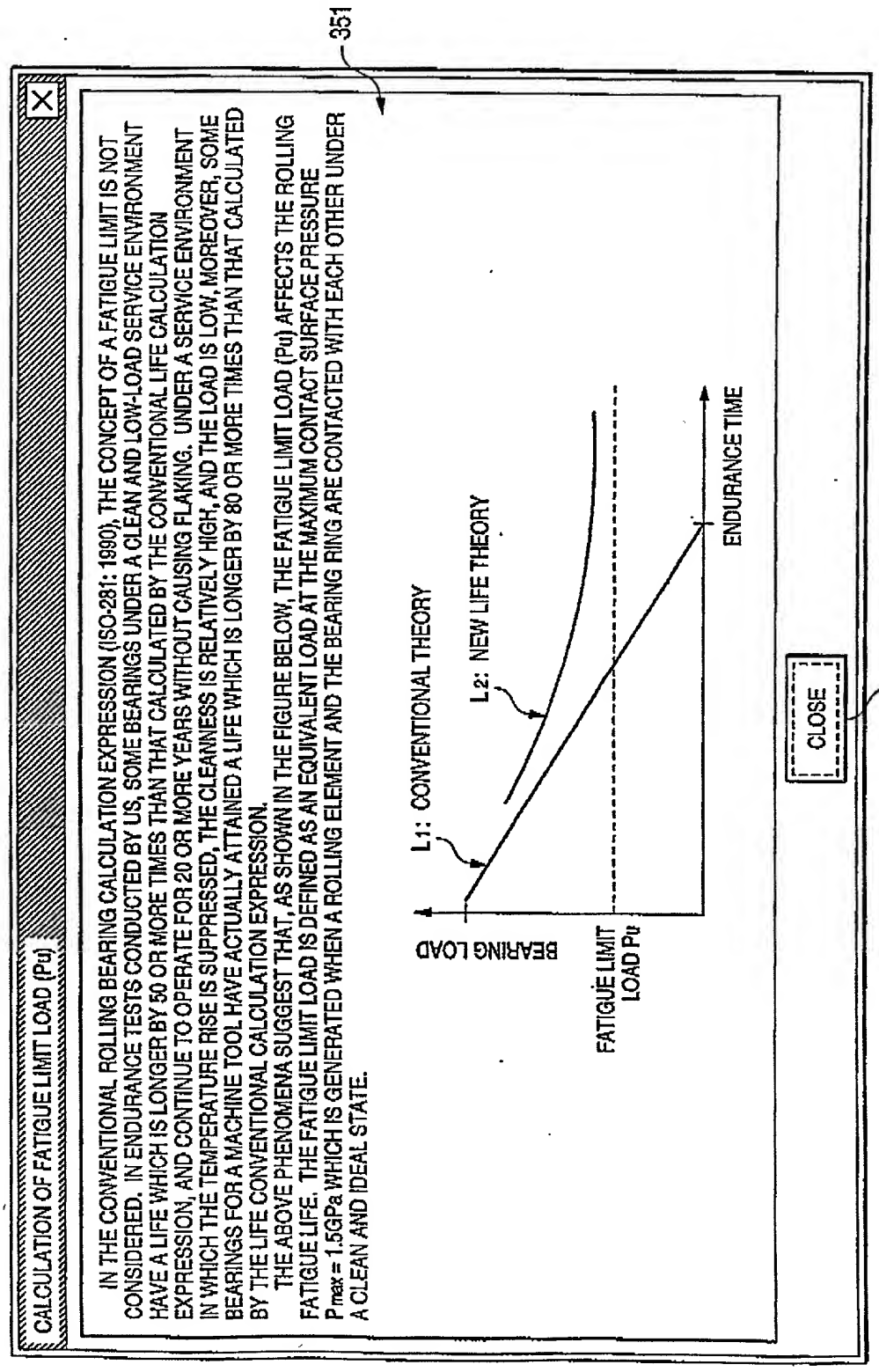

CALCULATION OF FATIGUE LIMIT LOAD (Pu)
IN THE CONVENTIONAL ROLLING BEARING CALCULATION EXPRESSION (ISO-281: 1990), THE CONCEPT OF A FATIGUE LIMIT IS NOT CONSIDERED. IN ENDURANCE TESTS CONDUCTED BY US, SOME BEARINGS UNDER A CLEAN AND LOW-LOAD SERVICE ENVIRONMENT HAVE A LIFE WHICH IS LONGER BY 50 OR MORE TIMES THAN THAT CALCULATED BY THE CONVENTIONAL LIFE CALCULATION EXPRESSION, AND CONTINUE TO OPERATE FOR 20 OR MORE YEARS WITHOUT CAUSING FLAKING. UNDER A SERVICE ENVIRONMENT IN WHICH THE TEMPERATURE RISE IS SUPPRESSED, THE CLEANNESS IS RELATIVELY HIGH, AND THE LOAD IS LOW, MOREOVER, SOME BEARINGS FOR A MACHINE TOOL HAVE ACTUALLY ATTAINED A LIFE WHICH IS LONGER BY 80 OR MORE TIMES THAN THAT CALCULATED BY THE LIFE CONVENTIONAL CALCULATION EXPRESSION.
THE ABOVE PHENOMENA SUGGEST THAT, AS SHOWN IN THE FIGURE BELOW, THE FATIGUE LIMIT LOAD (Pu) AFFECTS THE ROLLING FATIGUE LIFE. THE FATIGUE LIMIT LOAD IS DEFINED AS AN EQUIVALENT LOAD AT THE MAXIMUM CONTACT SURFACE PRESSURE Pmax = 1.5GPa WHICH IS GENERATED WHEN A ROLLING ELEMENT AND THE BEARING RING ARE CONTACTED WITH EACH OTHER UNDER A CLEAN AND IDEAL STATE.
L1: CONVENTIONAL THEORY
L2: NEW LIFE THEORY
BEARING LOAD
FATIGUE LIMIT LOAD Pu
ENDURANCE TIME
CLOSE
351
352

FIG. 23

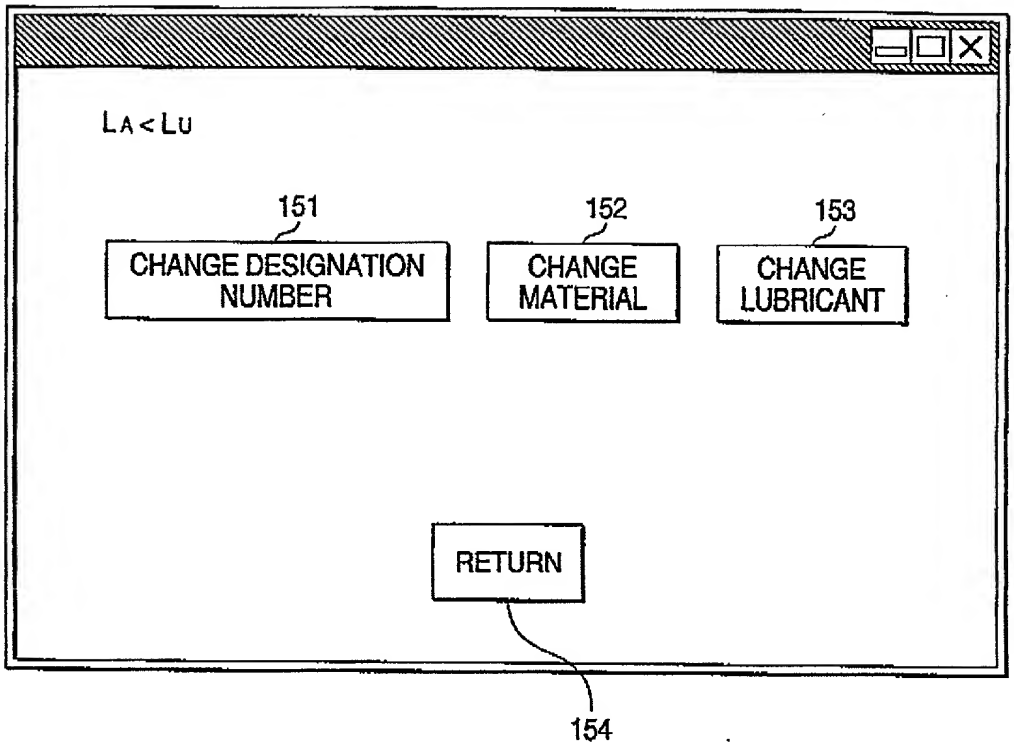

LA < LU
151
CHANGE DESIGNATION NUMBER
152
CHANGE MATERIAL
153
CHANGE LUBRICANT
RETURN
154

FIG. 24

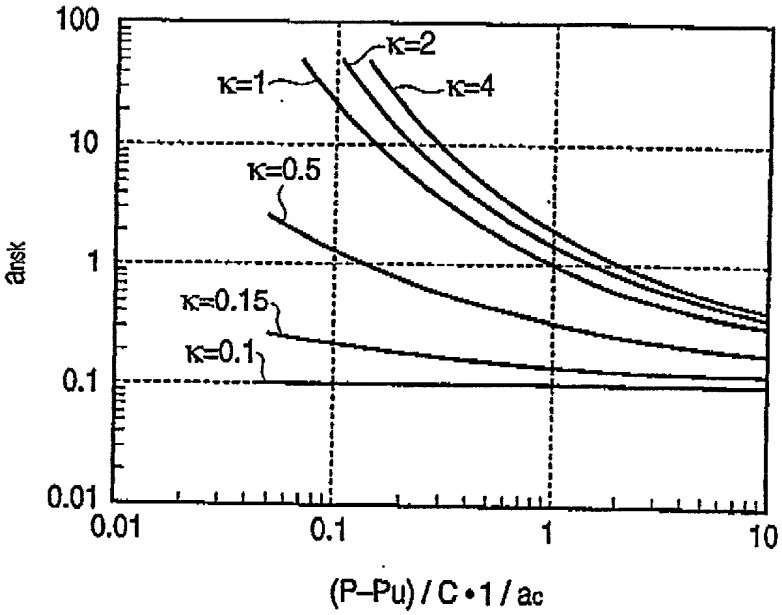


FIG. 25

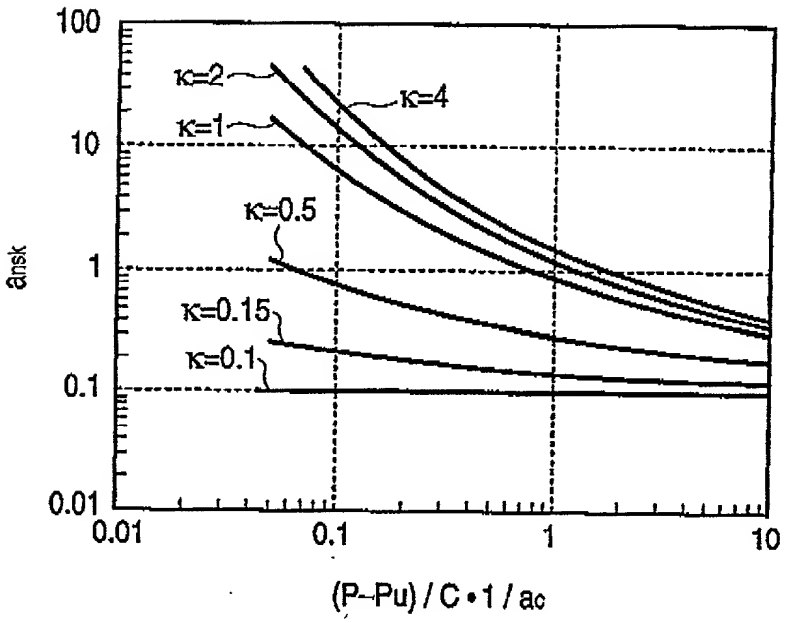

100
10
1
0.1
0.01
ansk
κ=2
κ=4
κ=1
κ=0.5
κ=0.15
κ=0.1
0.01
0.1
1
10
(P-Pu) / C • 1 / ac

FIG. 26

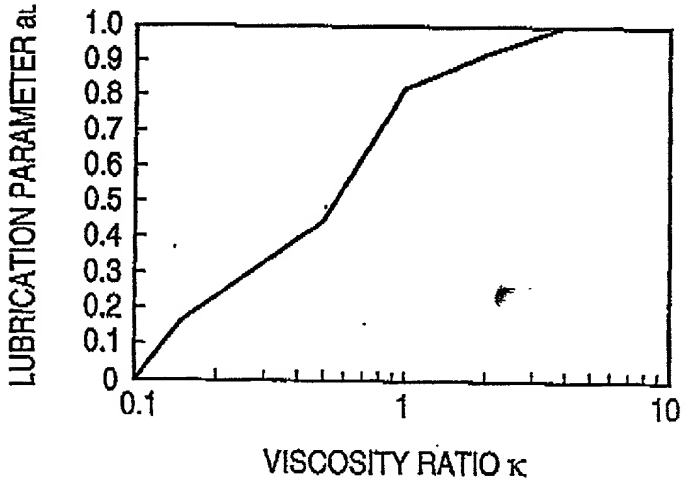

LUBRICATION PARAMETER aL
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
VISCOSITY RATIO κ

FIG. 27

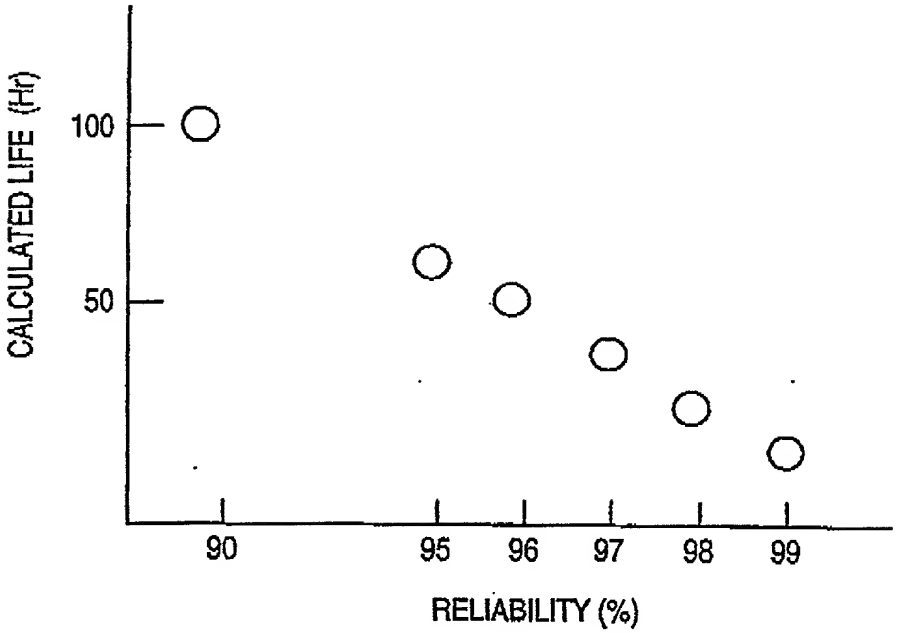

CALCULATED LIFE (Hr)
100
50
90
95
96
97
98
99
RELIABILITY (%)

FIG. 28

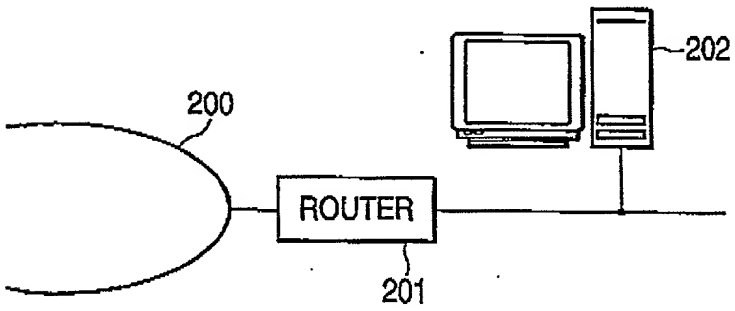
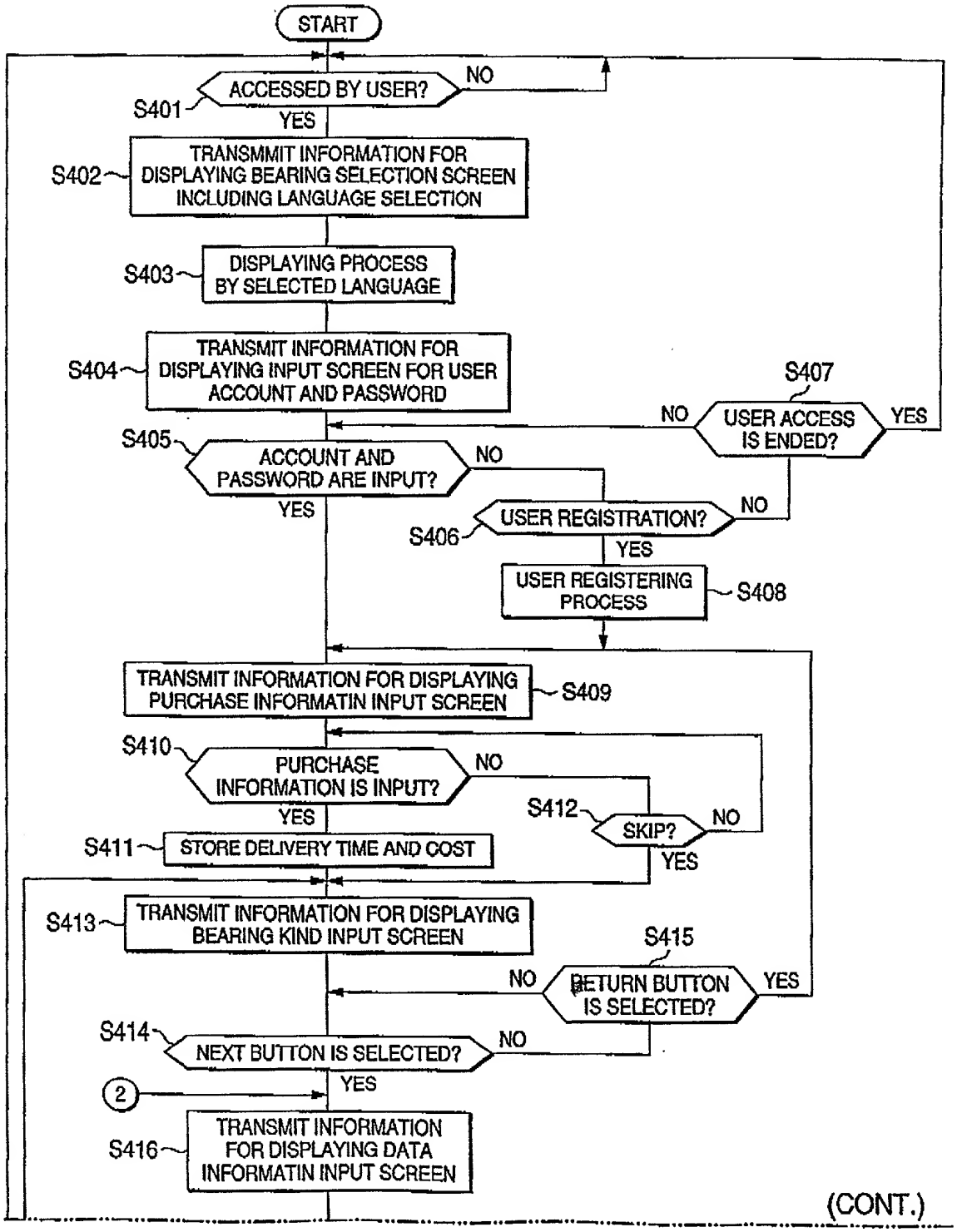

202
200
ROUTER
201

FIG. 29


START
S401
ACCESSED BY USER?
NO
YES
S402
TRANSMMIT INFORMATION FOR DISPLAYING BEARING SELECTION SCREEN INCLUDING LANGUAGE SELECTION
S403
DISPLAYING PROCESS BY SELECTED LANGUAGE
S404
TRANSMIT INFORMATION FOR DISPLAYING INPUT SCREEN FOR USER ACCOUNT AND PASSWORD
S407
USER ACCESS IS ENDED?
NO
YES
S405
ACCOUNT AND PASSWORD ARE INPUT?
NO
YES
S406
USER REGISTRATION?
NO
YES
USER REGISTERING PROCESS
S408
TRANSMIT INFORMATION FOR DISPLAYING PURCHASE INFORMATIN INPUT SCREEN
S409
S410
PURCHASE INFORMATION IS INPUT?
NO
YES
S412
SKIP?
NO
YES
S411
STORE DELIVERY TIME AND COST
S413
TRANSMIT INFORMATION FOR DISPLAYING BEARING KIND INPUT SCREEN
S415
RETURN BUTTON IS SELECTED?
NO
YES
S414
NEXT BUTTON IS SELECTED?
NO
YES
2
S416
TRANSMIT INFORMATION FOR DISPLAYING DATA INFORMATIN INPUT SCREEN
(CONT.)

(FIG. 29 CONTINUED)

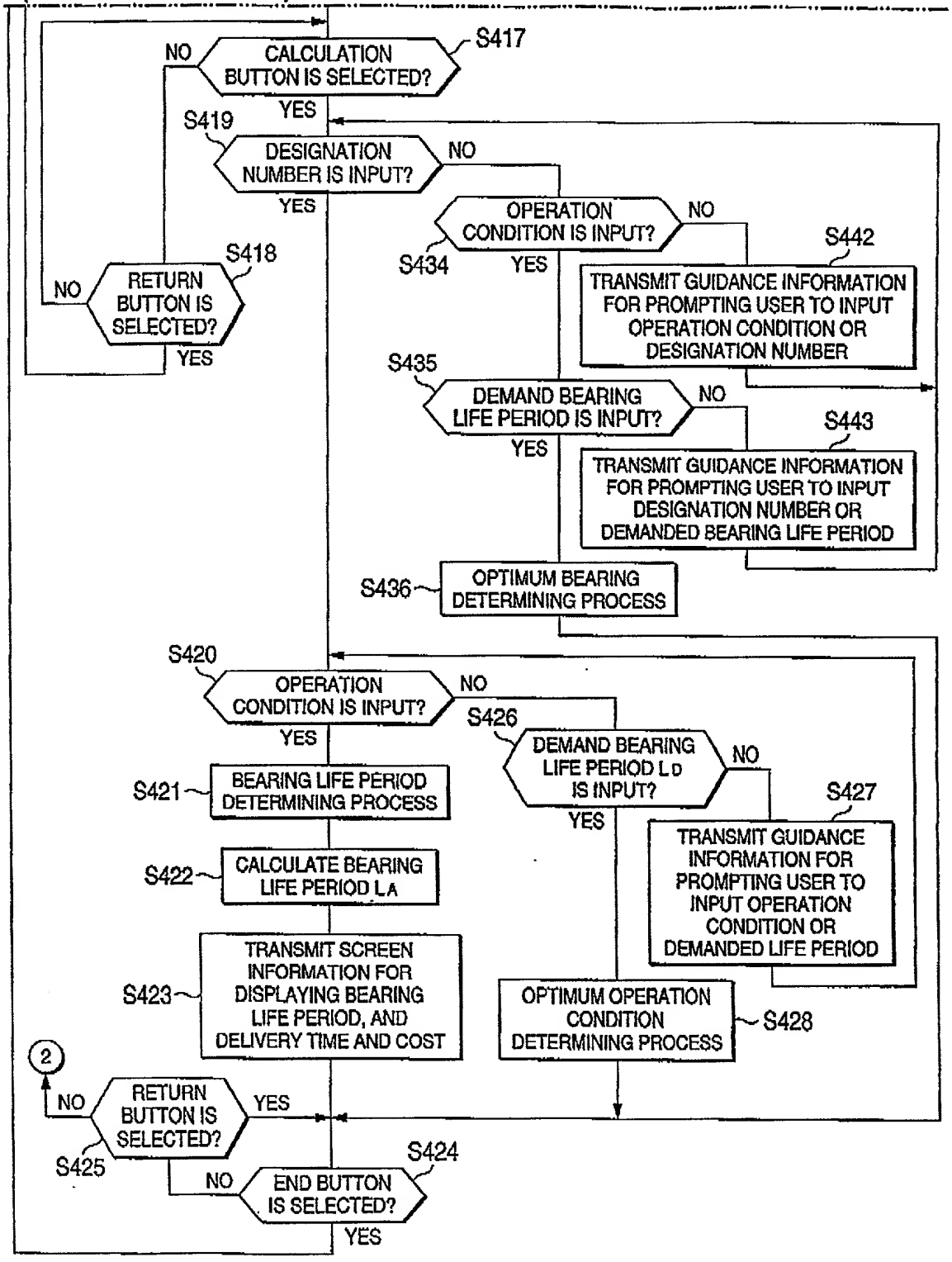


FIG. 30

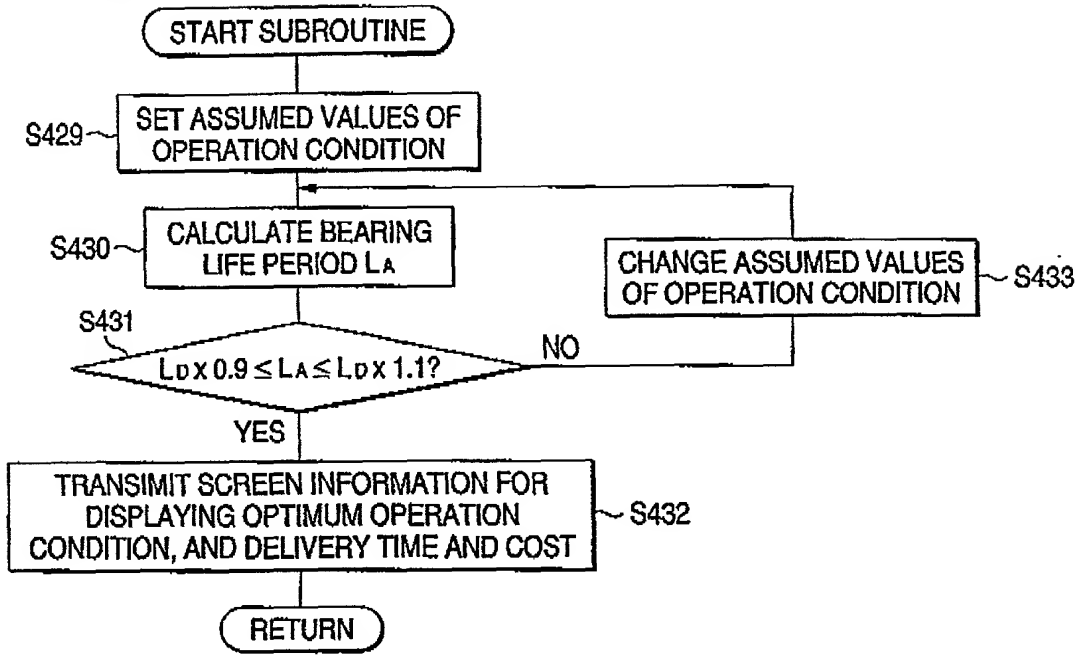

START SUBROUTINE
S429
SET ASSUMED VALUES OF OPERATION CONDITION
S430
CALCULATE BEARING LIFE PERIOD LA
S431
LDX 0.9 ≤ LA ≤ LDX 1.1?
NO
CHANGE ASSUMED VALUES OF OPERATION CONDITION
S433
YES
TRANSIMIT SCREEN INFORMATION FOR DISPLAYING OPTIMUM OPERATION CONDITION, AND DELIVERY TIME AND COST
S432
RETURN

FIG. 31

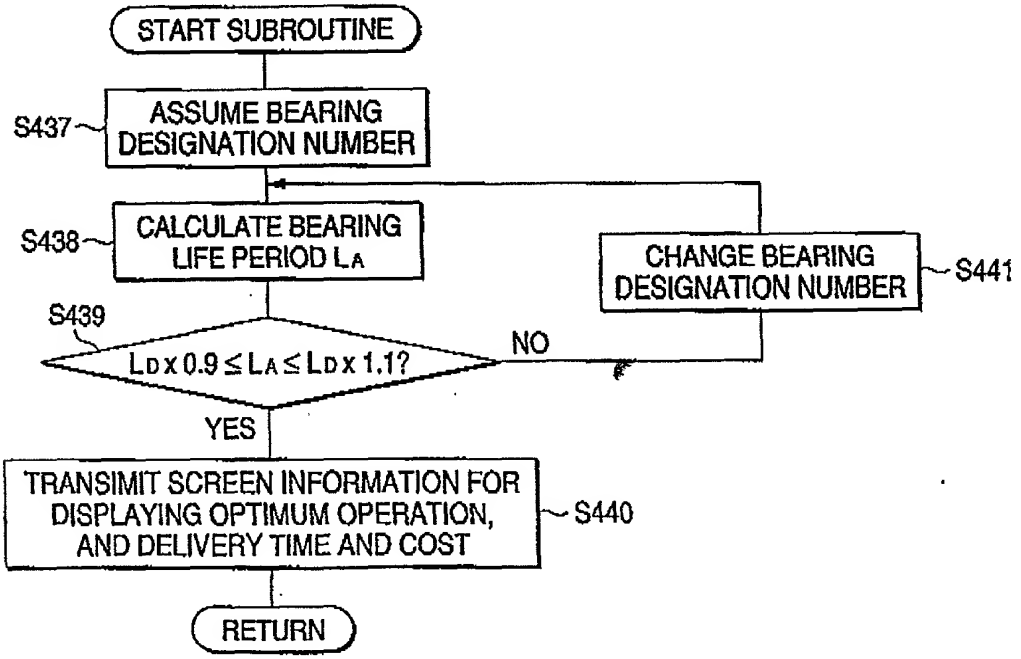

START SUBROUTINE
S437
ASSUME BEARING DESIGNATION NUMBER
S438
CALCULATE BEARING LIFE PERIOD LA
S439
LDX 0.9 ≤ LA ≤ LDX 1.1?
NO
CHANGE BEARING DESIGNATION NUMBER
S441
YES
TRANSIMIT SCREEN INFORMATION FOR DISPLAYING OPTIMUM OPERATION, AND DELIVERY TIME AND COST
S440
RETURN

FIG. 32

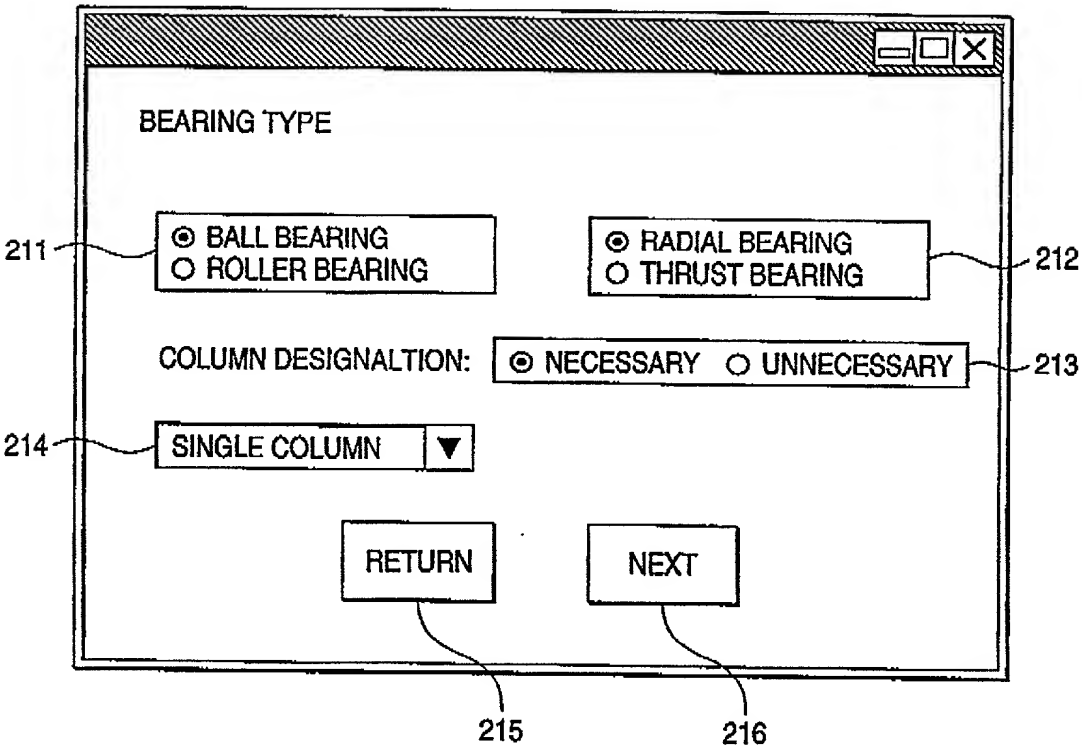

BEARING TYPE
211
BALL BEARING
ROLLER BEARING
RADIAL BEARING
THRUST BEARING
212
COLUMN DESIGNALTION:
NECESSARY
UNNECESSARY
213
214
SINGLE COLUMN
RETURN
NEXT
215
216

FIG. 33

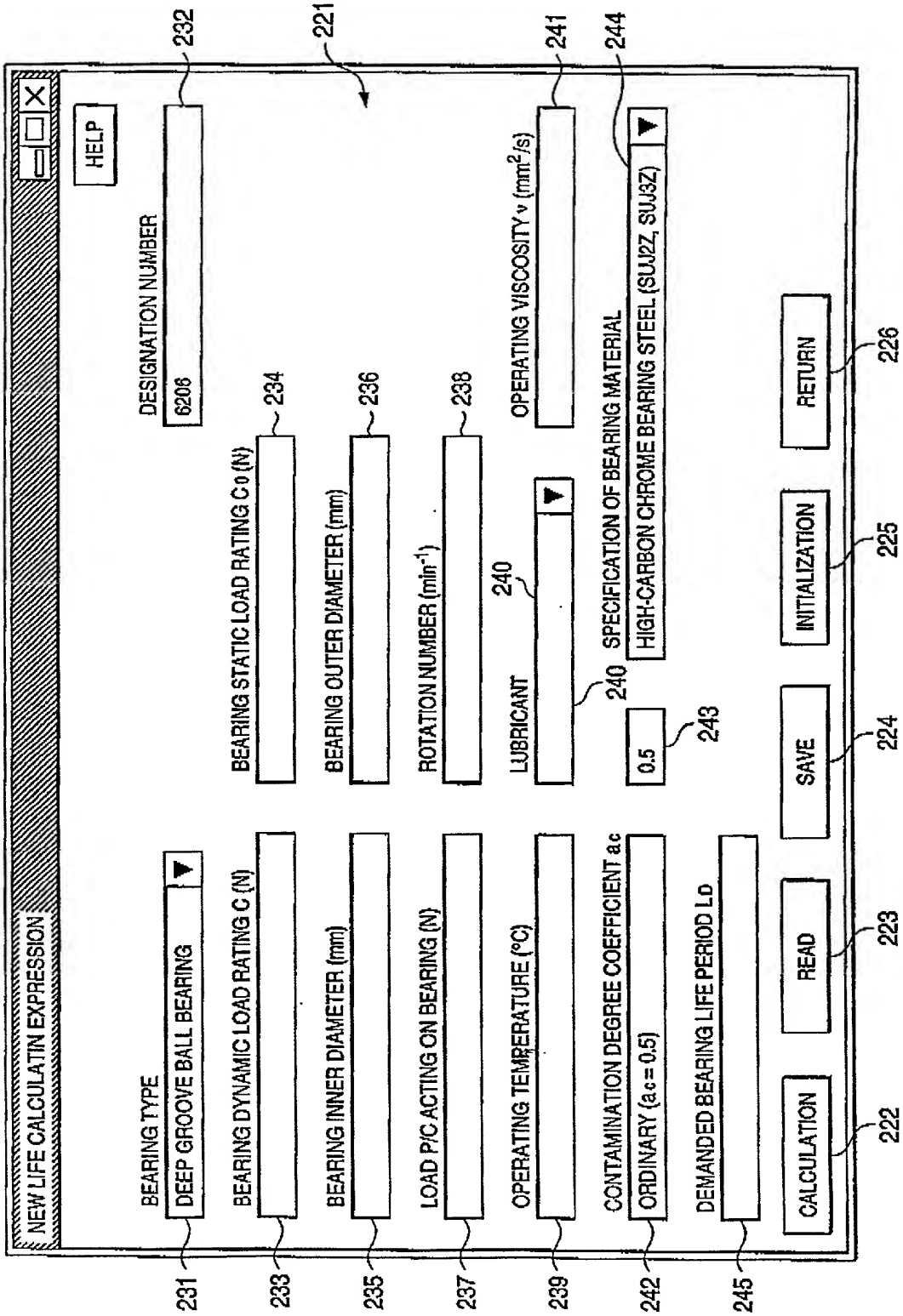

NEW LIFE CALCULATIN EXPRESSION
HELP
DESIGNATION NUMBER
6206
BEARING TYPE
DEEP GROOVE BALL BEARING
BEARING DYNAMIC LOAD RATING C (N)
BEARING INNER DIAMETER (mm)
LOAD P/C ACTING ON BEARING (N)
OPERATING TEMPERATURE (°C)
CONTAMINATION DEGREE COEFFICIENT ac
ORDINARY (ac = 0.5)
DEMANDED BEARING LIFE PERIOD LD
BEARING STATIC LOAD RATING Co (N)
BEARING OUTER DIAMETER (mm)
ROTATION NUMBER (min-1)
LUBRICANT
0.5
OPERATING VISCOSITY ν (mm2/s)
SPECIFICATION OF BEARING MATERIAL
HIGH-CARBON CHROME BEARING STEEL (SUJ2Z, SUJ3Z)
CALCULATION
READ
SAVE
INITIALIZATION
RETURN
221
222
223
224
225
226
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245

FIG. 34 (a)

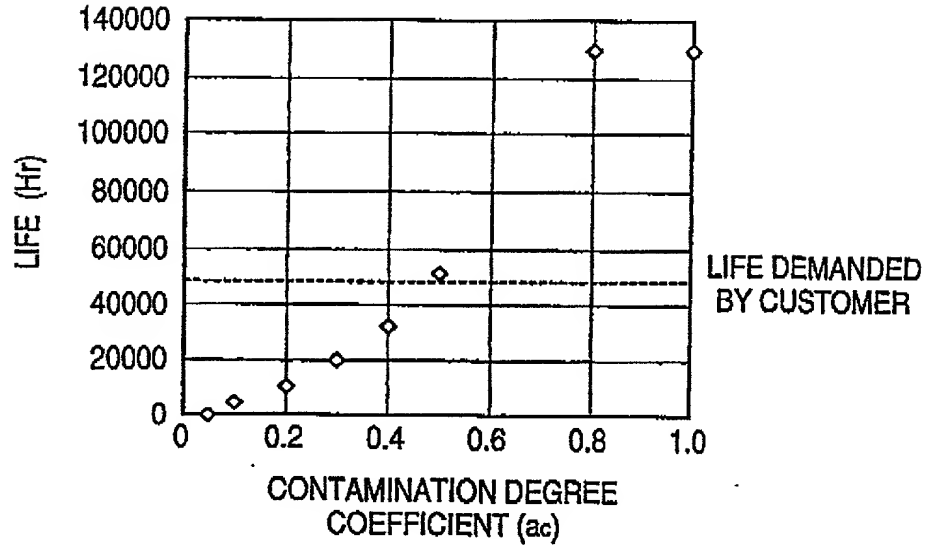
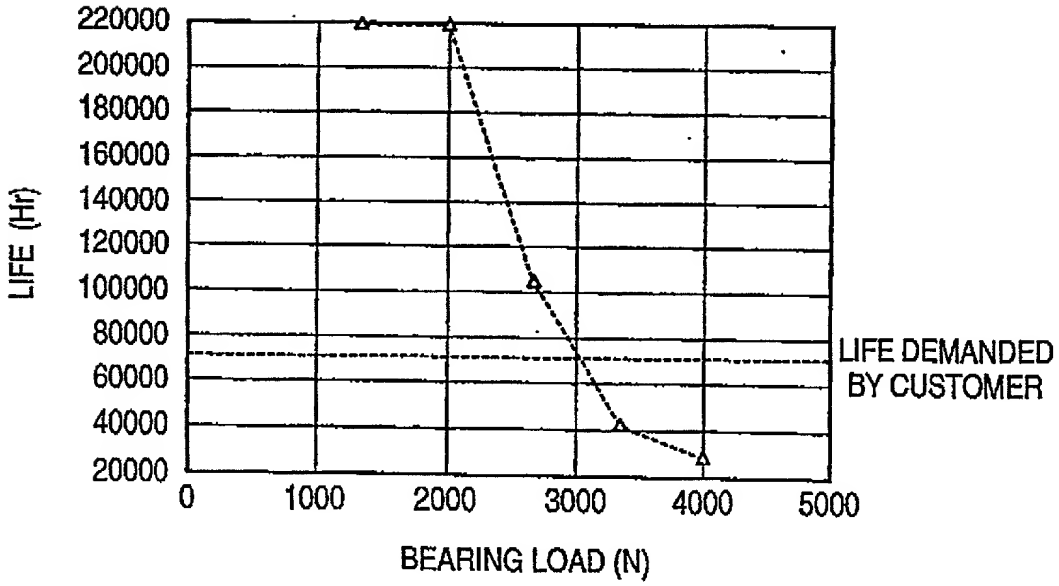



FIG. 34 (b)